

A Science Fit for the Chapel: Astronomy in Nineteenth-Century Wales

by

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## ABSTRACT

### **A Science Fit for the Chapel: Astronomy in Nineteenth-Century Wales**

Astronomy was a culturally prominent practice during the nineteenth century in Britain. In this thesis I examine the development of astronomy in one area, Wales. Astronomy became an important subject in the lecturing industry that emerged during the century as lecturers promoted astronomical narratives using sublime images with religious aspects. Using orreries, magic lanterns, and planetariums, lecturers brought astronomical phenomena to a new and engaged public. Town halls, chapels, Sunday schools, and theatres were transformed into temporary spaces for the consumption of scientific knowledge to ever-growing audiences. Scientific interests grew from lectures, and in the 1830s local science societies were established in numerous Welsh towns that sought to create a permanent space for the production and consumption of knowledge. By 1848, the British Association for the Advancement of Science's meeting in Swansea demonstrated Welsh people's desire to link to the centre of a growing scientific community in England.

A growing Welsh literate public engaged with astronomy through new publications that expressed astronomy's connection to cultural myths, heritage, and folklore. The start of Welsh-language astronomical initiatives placed science at the forefront of a new Welsh culture and identity as authors characterized astronomy as a distinctly Welsh tradition. Publications framed astronomers as druids who were the gatekeepers of scientific knowledge and the wielders of cultural and scientific authority. Books, periodicals, and journals helped shape the public's understanding of astronomy and forwarded notions of religious devotion, practical education, and a scientific heritage.

Astronomers were sometimes portrayed by newspapers and periodicals as new-age druids and bards who embodied a Welsh cultural tradition. The most prominent Welsh astronomers, including Robert Roberts, Edward Mills, and John Jones, exemplified astronomy as a Welsh activity. They became local heroes in the public imagination because of their status as Welsh-speaking poet-astronomers. The Welsh public perceived them as pious educators and social leaders who were the torch bearers of a druidic heritage. Their observatories and telescopes became symbols of astronomical and cultural authority that further enshrined astronomy as a devout and enlightening practice.

The first decades of the century saw astronomers, popular lecturers, and publishers work to establish a foundation for an astronomical community which flourished in the midcentury with the growth of astronomical activities, institutions, and publications. By the late century, the Astronomical Society of Wales represented the unification of Welsh astronomical efforts into a single institutional entity. Its journal, the *Cambrian Natural Observer*, reflected Welsh perceptions of astronomy as a communal and cooperative endeavour where members worked together to pursue astronomy as a serious leisure activity.

Astronomy in Wales has been largely ignored by historians of British science in the nineteenth century, and by more general Welsh historians. However, its development over the century reveals the profound significance of science in public culture. Popular science lecturers, astronomers, and publications solidified astronomy's position as a particularly Welsh activity. I will argue that astronomy reflected Welsh themes of religious devotion, practical education, and cultural heritage because it played an important role in reconstituting Welsh culture and identity in the nineteenth century.

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**TABLE OF CONTENTS**

List of Figures	vi
Introduction	1
Chapter 1. “grandfathers of the Ether”: Lecturing, Education, and Popular Science	18
Chapter 2. “what can be more weird, more wonderful, more stupendous than the teachings of Astronomy?”: Astronomers, Observatories, and Telescopes	51
Chapter 3. “of Celtic derivation”: Astronomical Publications and the Production and Consumption of Scientific Knowledge	86
Conclusion	113
Bibliography	115

## LIST OF FIGURES

- |    |   |      |
|----|---|------|
| 1. | Map of Britain and Ireland.<br>R. Wilkinson, <i>The British Isles</i> (London: R. Wilkinson, 1812). The British Library.  | viii |
| 2. | Map of Wales.<br>R. Wilkinson, <i>The British Isles</i> (London: R. Wilkinson, 1812). The British Library.  | ix   |
| 3. | Joseph Wright of Derby, <i>A Philosopher Lecturing on the Orrery</i> , Derby Museum and Art Gallery, 1766.<br>Reproduced from Henry King, <i>Geared to the Stars: The Evolution of Planetariums, Orreries, and Astronomical Clocks</i> (Toronto: University of Toronto Press, 1978), 166.             | 21   |
| 4. | Walker's exhibition of the Eidouranion in the English Opera House, Strand, March 21, 1817. Victoria and Albert Museum.<br>Reproduced from Henry King, <i>Geared to the Stars: The Evolution of Planetariums, Orreries, and Astronomical Clocks</i> (Toronto: University of Toronto Press, 1978), 315. | 24   |
| 5. | Keevil's Magic Lantern slide used in a lecture in 1838.<br>Reproduced from Jan Golinski, "Sublime Astronomy: The Eidouranion of Adam Walker and His Sons," <i>Huntington Library Quarterly</i> 80, no. 1 (2017): 147.   | 31   |
| 6. | John Jones with his 8-inch homemade reflecting telescope, Jumbo.<br>J. Silas Evans, <i>Seryddiaeth a Seryddwr</i> (Cardiff: William Lewis, 1923), 273.  | 63   |
| 7. | The Moon, photographed by G. Parry Jenkins using a 16-inch reflector, February 14, 1891.<br>"The Solar System," <i>Journal of the Astronomical Society of Wales</i> 2, no. 1 (1896): 15.  | 82   |
| 8. | A comparison of different members' drawings of Jupiter.<br>"Jupiter, 1896," <i>Journal of the Astronomical Society of Wales</i> 2, no. 3 (1896): 45.  | 83   |
| 9. | A Lithograph of a "ruby amphitheater" described in the <i>Sun</i> , August 28, 1835.  | 91   |

Reproduced from Michael J. Crowe, *The Extraterrestrial Life Debate: Antiquity to 1915* (Notre Dame: University of Notre Dame Press, 2008), 273.

10. Advertisement for a reflecting telescope directed at students learning astronomy. 105  
“Queries,” *Journal of the Astronomical Society of Wales* 1, no. 2 (1895): 18.
11. Late eighteenth-century depiction of a Welsh druid playing the harp. 107  
Thomas Pennant, *A Tour in Wales* (London: Henry Hughes, 1778), 144/1.

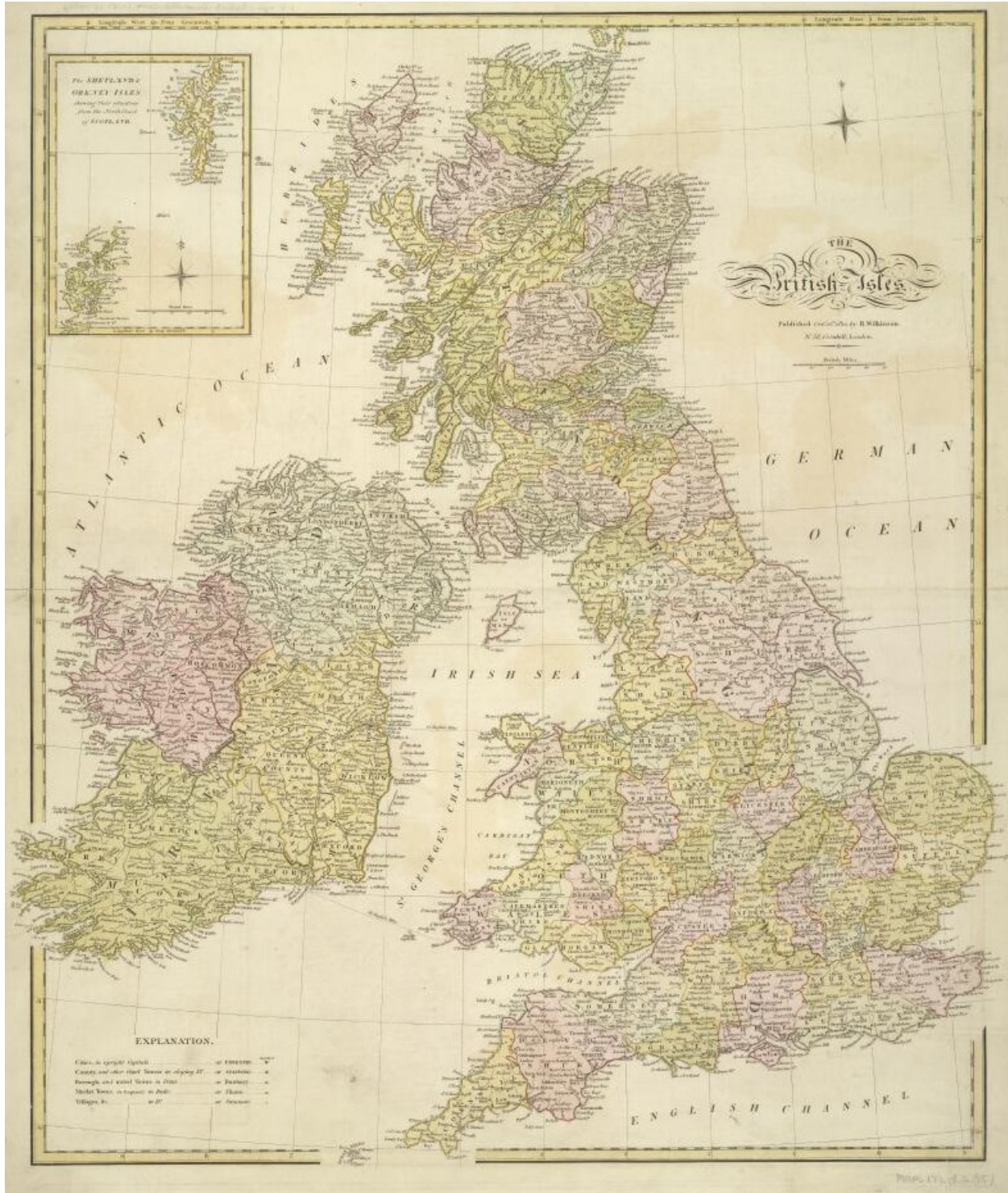


Figure 1.  
 Map of Britain and Ireland.  
 R. Wilkinson, *The British Isles* (London: R. Wilkinson, 1812). The British Library.



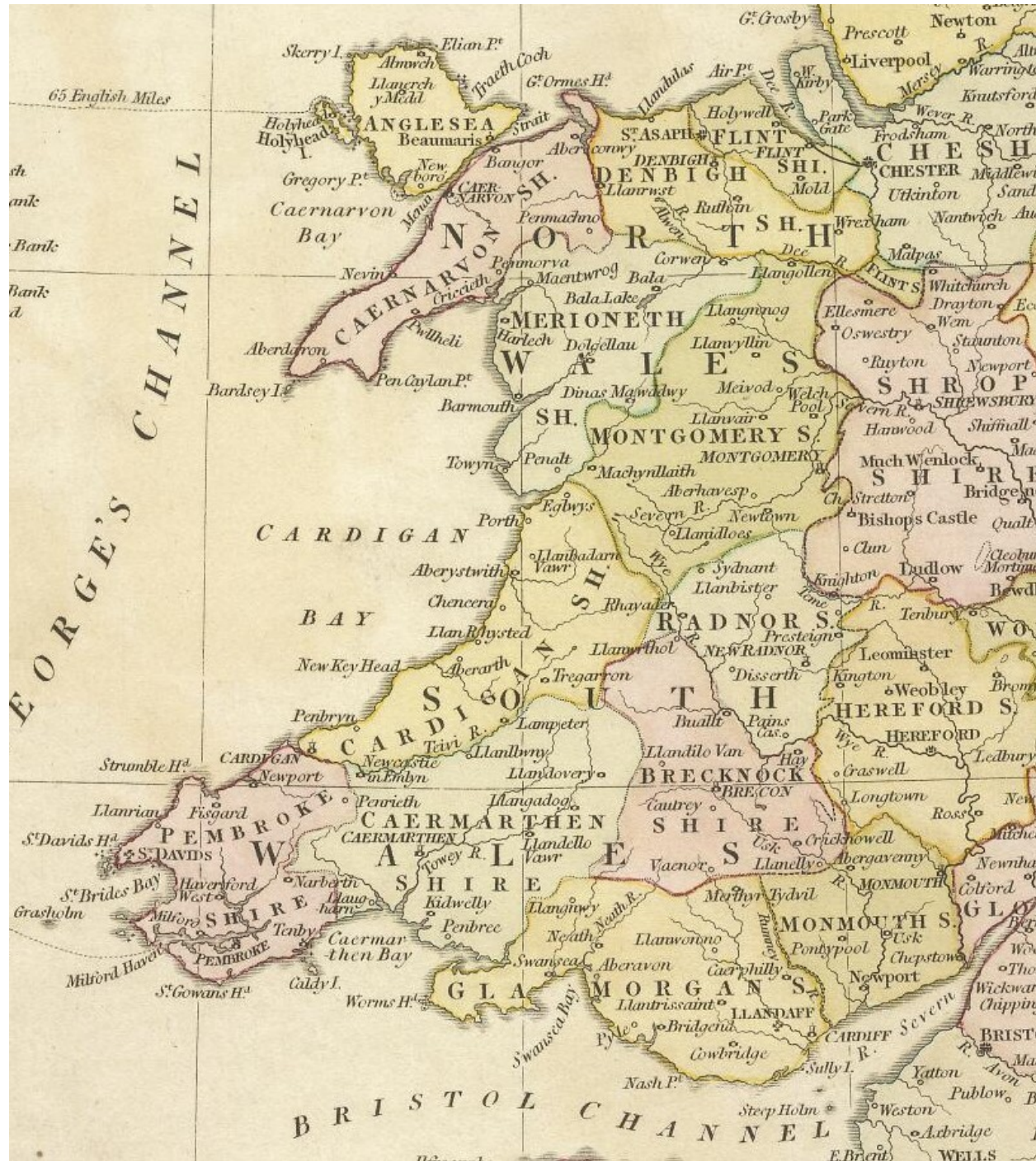


Figure 2.  
Map of Wales.  
R. Wilkinson, *The British Isles* (London: R. Wilkinson, 1812). The British Library.

## Introduction

No science is more important in its bearings upon our religious and moral principles- few more interesting and attractive to all classes and conditions, than Astronomy.<sup>1</sup>

Reporting in 1845 on a recent lecture by a Mr. Franklin, the *Pembrokeshire Herald* recounted that Franklin was raucously applauded by the audience in Haverfordwest for his performance. Through the use of visual aids that demonstrated the movements of the heavens, Franklin discussed the religious and Biblical aspects of the study of astronomy, garnering more support than any other previous visiting lecturer.

Franklin serves as one example of the significant position astronomy held in public culture. Astronomy functioned in nineteenth-century Wales as a conduit for cultural expression, religious devotion, and practical education. Attendees of lectures and readers of astronomical literature alike expressed fascination with the sublime scenery of the heavens while newspapers and periodicals lauded the social and practical benefits of scientific learning.

The nineteenth century was a pivotal period of development for astronomy in Wales. The first decades of the century saw astronomers, popular lecturers, and publishers work to establish a foundation for an astronomical community which flourished in the midcentury with the growth of astronomical activities, institutions, and publications. Local scientific societies were established in numerous Welsh towns that sought to become part of an emerging network that linked Wales with the centre of the scientific community in England. However, the start of Welsh-language astronomical initiatives also placed science at the forefront of Welsh culture and identity as authors characterized astronomy as a distinctly Welsh tradition. Publications framed astronomers as the gatekeepers of scientific knowledge and the wielders of cultural and scientific

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<sup>1</sup> "Lectures on Astronomy," *Pembrokeshire Herald and General Advertiser*, January 17, 1845, <http://newspapers.library.wales/view/3051863/3051866/23>.

authority. By the late century, the Astronomical Society of Wales represented the unification of Welsh astronomical efforts into a single institutional entity. Its journal, the *Cambrian Natural Observer*, reflected Welsh perceptions of astronomy as a communal and cooperative activity. This thesis argues that the cultural values of astronomy in Wales were asserted through the efforts of lecturers, astronomers, and publishers.

### Science in Nineteenth-Century Britain and Ireland

The cultural prominence of science in Wales mirrored developments in Britain and Ireland during the nineteenth century. A new generation of middle class consumers created a market for popular science education to flourish amidst a communications revolution that transformed the relationship between knowledge, readers, and the market.<sup>2</sup> Katharine Anderson, Aileen Fyfe, Jan Golinski, Bernard Lightman, and Ralph O'Connor, among others, have examined the emergence of popular science in Britain.<sup>3</sup> How science was depicted to the public was important for the credibility of both lectures and publications. Gillian Jane Daw, Elizabeth Kessler, Omar Nasim, David Nye, and Alex Pang have discussed the connection between aesthetics and science, and how aesthetic codes were implemented by performers and publishers to appeal to wide audiences.<sup>4</sup> Eminent lecturers such as Adam Walker and Sir Robert Ball fused

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<sup>2</sup> James Secord, *Victorian Sensation: The Extraordinary Publication, Reception, and Secret Authorship of Vestiges of the Natural History of Creation* (Chicago: University of Chicago Press, 2000), 506.

<sup>3</sup> Katharine Anderson, *Predicting the Weather: Victorians and the Science of Meteorology* (Chicago: University of Chicago Press, 2005); Aileen Fyfe and Bernard Lightman, ed. *Science in the Marketplace: Nineteenth-Century Sites and Experiences* (Chicago: University of Chicago Press, 2007); Jan Golinski, "Sublime Astronomy: The Eidouranian of Adam Walker and His Sons," *Huntington Library Quarterly* 80, no. 1 (2017): 135-157; Bernard Lightman, *Victorian Popularizers of Science: Designing Nature for New Audiences* (Chicago: University of Chicago Press, 2007); Ralph O'Connor, *The Earth on Show: Fossils and the Poetics of Popular Science, 1802-1856* (Chicago: University of Chicago Press, 2007).

<sup>4</sup> Gillian Jane Daw, "The Victorian Poetic Imagination and Astronomy: Tennyson, De Quincey, Hopkins and Hardy" (PhD diss., University of Sussex, 2012), 12-20; Elizabeth A. Kessler, *Picturing the Cosmos: Hubble Space Telescope Images and the Astronomical Sublime* (Minneapolis: University of Minnesota Press, 2012), 5-20; Omar Nasim, *Observing by Hand: Sketching the Nebulae in the Nineteenth Century* (Chicago: University of Chicago Press, 2014), 84-122; David E. Nye, *American Technological Sublime* (Cambridge: MIT Press, 1994), xiii-xviii, 2-6;

entertainment with education, creating a unique experience that transformed popular culture and changed how science was perceived and practiced by the public.<sup>5</sup> Public perceptions of science were also altered by new developments in the mass publication press which reshaped the dynamics of scientific authorship and audience.<sup>6</sup> James Secord's analysis on the publication of *Vestiges of the Natural History of Creation* demonstrates the impact that publishers had on the burgeoning reading market by releasing books with scientific themes.<sup>7</sup> Popular science writers and performers produced a new space for scientific learning and understanding that sometimes contrasted sharply with the narratives of increasingly professional scientific practitioners.

Nineteenth-century publications reveal the changing relationship between science and religion. Aileen Fyfe discusses the relationship between science and religion. She focuses on the religious reaction to the perceived threat posed by the questionable morals of science publishers in the mid-nineteenth century.<sup>8</sup> Evangelicals were knowledgeable in the sciences and they played a major role in the publishing of popular scientific material aimed at a wide audience.<sup>9</sup> Religious publishers offered appealing reading material that advanced natural theological notions which conflicted with progressively professionalized science during the second half of the century.<sup>10</sup> Geology, astronomy, and phrenology were the most religiously-compatible sciences, if they were properly interpreted. Jonathan Topham argues that published religious articles were valued for

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Alex Pang, "Technology, Aesthetics, and the Development of Astrophotography at the Lick Observatory," in *Inscribing Science: Scientific Texts and the Materiality of Communication*, ed. Timothy Lenoir (Stanford: Stanford University Press, 1998), 223-248.

<sup>5</sup> For more on Walker, see Golinski, "Sublime Astronomy," 136-148. For more on Ball, see Lightman, *Victorian Popularizers of Science*, 353-422.

<sup>6</sup> Lightman, 13.

<sup>7</sup> Secord, *Victorian Sensation*, 11-40. See also, James Secord, *Visions of Science: Books and Readers at the Dawn of the Victorian Age* (Oxford: Oxford University Press, 2014), 2-21.

<sup>8</sup> Aileen Fyfe, *Science and Salvation: Evangelical Popular Science Publishing in Victorian Britain* (Chicago: University of Chicago Press, 2004).

<sup>9</sup> Fyfe, *Science and Salvation*, 3-14.

<sup>10</sup> Natural Theology being the belief that the existence of God can be discerned by studying the natural world. A.J. Meadows, "Astronomy and Geology, Terrible Muses! Tennyson and 19<sup>th</sup>-Century Science," *Notes and Records of the Royal Society of London* 46, no. 1 (1992): 114.

their “safe science,” meaning science that did not challenge religious beliefs, but rather reinforced them.<sup>11</sup> Whether or not a source mentioned God was important for authors’ credibility. The way science was presented and interpreted was a matter of concern, then, to astronomers, religious figures, and the wider reading public, and varied publications and performances depending on the intended audience.<sup>12</sup>

The development of popular science facilitated the growth of new audiences and consumers of knowledge while also enabling new producers of scientific material. Specifically, the growth of print literature enabled women to become far more involved in science. Women gained authority as scientific educators and authors despite some male practitioners who attempted to disqualify them.<sup>13</sup> In astronomy, Mary Agnes Clerke and Agnes Giberne wrote significant books, periodicals, and essays in the late century. Their popular works were intended to make astronomy more accessible to readers. Not only were Clerke and Giberne prominent popular science authors, but they were also involved in the latest astronomical developments. They presented themselves as “synthesizers” of astronomy and worked to set the agenda for future research.<sup>14</sup> By the late nineteenth century, more women were acknowledged by their peers as legitimate practitioners of science.<sup>15</sup>

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<sup>11</sup> Jonathan R. Topham, “Science and Popular Education in the 1830s: The Role of the “Bridgewater Treatises,”” *The British Journal for the History of Science* 25, no. 4 (1992): 404.

<sup>12</sup> Fyfe, *Science and Salvation*, 14.

<sup>13</sup> Bernard Lightman devotes a chapter to women writers of popular science. See, Lightman, *Victorian Popularizers of Science*, 95-166. There are several other works on the role of women in science more generally. See Patricia Fara, *Pandora’s Breeches: Women, Science, and Power in the Enlightenment* (London: Pimlico, 2004); Ludmilla Jordanova, *Sexual Visions: Images of Gender in Science and Medicine between the Eighteenth and Twentieth Centuries* (Madison: Wisconsin Press, 1989). For more on women in astronomy, see K.R. Lafortune, “Women at the Harvard College Observatory, 1877-1919: ‘Women’s Work’, the ‘New’ Sociality of Astronomy, and Scientific Labor” (MA diss., University of Notre Dame, 2001).

<sup>14</sup> Giberne was on the committee that founded the British Astronomical Association. Clerke maintained an international network of practitioners at the forefront of astronomical research and even became an expert on the interpretation of astrophotography and spectroscopy. She was friends with prominent astronomers including Norman Lockyer, William and Margaret Huggins, and David Gill. Lightman, 475-478.

<sup>15</sup> Many women were still not independently recognized practitioners, but were often legitimized by working closely with their husbands. The theme of scientific couples along with other women assistants was prominent in the



The nineteenth century represented a new era of producers and consumers of scientific knowledge which transformed the image of scientific practice in the public. These changes impacted how practitioners of science perceived their own roles in the wider public and sparked new debates on how science should be practiced and who was a recognized member of growing national and international scientific networks. The rise of popular science in the nineteenth century prompted some practitioners of science to question the integrity of the emergent scientific community. Previously, historians have examined the century through the lenses of amateur and professional (or popular and specialist) science, but this dichotomy has proved to be ambiguous at best.

### **Amateurs and Professionals**

Historians of science have focused on the emergence of modern scientific institutions in the nineteenth century and the changing roles of professionals and amateurs. However, these two groups were not well-defined, and amateurs and professionals often operated within the same networks. The significance of the professionalization movement and the role of Thomas Henry Huxley and his X-Club in the nineteenth century has been studied by, among others, Ruth Barton and Adrian Desmond.<sup>16</sup> Alternatively, Lightman's work has de-centred studies away from the professionalizers and has included clergymen, women, and popular science writers as subjects in

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century. They represent a significant group of previously ignored support personnel in science. For more, see Barbara Becker, *Unravelling Starlight: William and Margaret Huggins and the Rise of the New Astronomy* (Cambridge: Cambridge University Press, 2011), 170-191; Mary T. Brück, *Women in Early British and Irish Astronomy: Stars and Satellites* (Dordrecht: Springer, 2009), 25-43; Patricia Fara, *Pandora's Breeches*, 9-31; Alex Pang, "Gender, Culture, and Astrophysical Fieldwork: Elizabeth Campbell and the Lick Observatory-Crocker Eclipse Expeditions," *Osiris* 11 (1996): 17-43; Susan McKenna-Lawlor, *Whatever Shines Should Be Observed: Quicquid Nitet Notandum* (Dordrecht: Springer, 2003), 77-94; Margaret W. Rossiter, "'Women's Work' in Science, 1880-1910," *Isis* 71, no. 3 (1980): 381-398.

<sup>16</sup> Ruth Barton, "'An Influential Set of Chaps': The X-Club and Royal Society Politics 1864-85." *The British Journal for the History of Science* 23, no. 1 (1990): 53-81; Adrian Desmond, *Huxley: From Devil's Disciple to Evolution's High Priest* (Reading: Addison-Wesley, 1997).

the history of science.<sup>17</sup> The definition of the amateur changed in the nineteenth century with the emergence of professionals. Amateurs could be considered, in one sense, as devotees who loved practicing science; but in another sense, they could be considered as superficial participants and dabblers.<sup>18</sup> Secord asserts that the division between “specialist” and “popular” practitioners of science is inappropriate when examining people of different gender, rank, and level of experience who both produced and consumed scientific knowledge in the nineteenth century.<sup>19</sup>

Definitions of what qualifies as “professional” have also been debated by historians. A.J. Meadows argues that a professional could be considered as anyone who devoted much of their time to science and scientific research, but Allan Chapman asserts that the only professionals in astronomy during the century were those making a salary in science.<sup>20</sup> However, salaried astronomers in nineteenth-century Britain were limited to university observatories and the Royal Observatory at Greenwich.<sup>21</sup> Professional astronomy was primarily restricted to official observatories that performed navigational work for the Admiralty.<sup>22</sup>

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<sup>17</sup> Lightman refers to these individuals as “practitioners” and “popularizers” of science rather than using the term “scientists.” Other names include gentlemen of science and men science, but the term “practitioners” is more inclusive of women and non-elites. Lightman, *Victorian Popularizers of Science*, 9-13.

<sup>18</sup> Robert A. Stebbins, *Amateurs, Professionals, and Serious Leisure* (Montreal: McGill-Queen’s University Press, 1992), 10.

<sup>19</sup> James Secord, “How Scientific Conversation Became Shop Talk,” in *Science in the Marketplace*, 23-59, 25.

<sup>20</sup> A.J. Meadows, *The Victorian Scientist: The Growth of a Profession* (London: British Library, 2004), 169; Allan Chapman, *The Victorian Amateur Astronomer: Independent Astronomical Research in Britain, 1820-1920* (Chichester: Wiley, 1998), 1-3. Other attempts have been made to count the number of professionals and amateurs involved in astronomy by John Lankford and Spencer Weart, John Heilbron, and Paul Foreman. For more, see John Lankford, *American Astronomy: Community, Careers, and Power, 1859-1940* (Chicago: University of Chicago Press, 1997), 2-6; Spencer Weart, John Heilbron, and Paul Foreman, “Physics circa 1900: Personnel, Funding, and Productivity of the Academic Establishments,” *Historical Studies in the Physical Sciences* 5 (1975): 1-185.

<sup>21</sup> At both Greenwich and University observatories, observatory directors played a significant role in determining the success of each institution. Roger Hutchins examines a number of professor-directors at different university observatories, and Robert Smith discusses George Biddel Airy’s directorship from 1835 to 1881. Airy transformed Greenwich into a prestigious international observatory that became the centre of the international scientific community. Roger Hutchins, *British University Observatories, 1772-1939* (Aldershot: Ashgate, 2008), 1-9; Robert W. Smith, “A National Observatory Transformed: Greenwich in the Nineteenth Century,” *Journal for the History of Astronomy* 22, no. 1 (1991): 5-20.

<sup>22</sup> Salaried observers practiced meridian astronomy for much of the nineteenth century, and consistency was a major concern for directors. Efforts were made by observatory directors to reduce the differences recorded by observers in the same situation, or to solve the “personal equation.” Simon Schaffer discusses how Airy and Bessel, through the

Much novel astronomical research was undertaken by independent astronomers who financed their own astronomical instruments and had the time and education to identify and address the latest astronomical problems. Chapman describes these astronomers as “Grand Amateurs” who operated mainly in London, Oxford, and Cambridge through the Royal Society and the British Association for the Advancement of Science.<sup>23</sup> Amateur astronomers possessed the highest quality telescopes and pursued the newest avenues of research, including investigating elements of binary stars, determining the structure of nebulae, and establishing the physical and chemical properties of stars through the use of the first spectroscopes. However, Chapman’s divisions become problematic when applied to areas outside the centre of the British astronomical community. Wales had no university or official observatories until the twentieth century and very few Welsh astronomers could be described as Grand Amateurs. Astronomers in Wales practiced astronomy for different motivations and their experiences do not fit into the Grand Amateur framework.

The state of astronomy in Wales more closely reflects Ireland than England. Irish astronomy has received significantly more attention than Wales from historians. There are a few explanations for this: Ireland boasted the largest telescope in the world for much of the nineteenth century in Lord Rosse’s Leviathan; Thomas and Howard Grubb were the most prolific telescope manufacturers across Britain and Ireland; Ireland maintained significant observatories at Dunsink and Armagh; the prolific group of Lord Rosse, William Rowan

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implementation of chronometric techniques and new measures, changed the regime of the observatory as they sought to “calibrate” observers in the same way one would calibrate an instrument. For more, see Simon Schaffer, “Astronomers Mark Time: Discipline and the Personal Equation,” *Science in Context* 2, no. 1 (1988): 115-145.

<sup>23</sup> For more on the Oxbridge network, see Robert W. Smith, “The Cambridge Network in Action: The Discovery of Neptune,” *Isis* 80, no. 3 (1989): 395-422. For more on the Royal Society, see Marie Boas Hall, *All Scientists Now: The Royal Society in the Nineteenth Century* (Cambridge: Cambridge University Press, 1984). For more on the British Association for the Advancement of Science, see Roy M. MacLeod and Peter Collins, ed. *The Parliament of Science: The British Association for the Advancement of Science, 1831-1981* (Northwood: Science Reviews, 1981)17-42.



Hamilton, Thomas Romney Robinson, Edward Cooper, and Robert S. Ball represented an Irish nucleus of astronomical influence and they worked together in both British and Irish institutions.<sup>24</sup> Irish science was far more institutionalized than science in Wales during the nineteenth century, as the Church and, later, the Department of Science and Art sought to control Irish science.<sup>25</sup> Comparatively, Wales had no overarching institutionalized control of science. In terms of astronomy, there was one prominent private observatory at Penllergare, no commercial telescope manufacturers, and a group of astronomers, including John Dillwyn Llewelyn, John William Thomas, Arthur Mee, and John Jones who have received very little scholarly attention.

Focusing on only the revolutionary research in the nineteenth century ignores the role that astronomy played in normal, everyday life. More historians of science, however, are broadening the scope of the history of science to include the working of what could be considered as “normal science” in the nineteenth century.<sup>26</sup> Juliana Adelman’s discussion on communities of science in nineteenth-century Ireland is especially applicable in a Welsh context.<sup>27</sup> Adelman’s framework can be used to examine the emerging astronomical community

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<sup>24</sup> David Attis and Charles Mollan, ed. *William Parsons, 3<sup>rd</sup> Earl of Rosse: Astronomy and the Castle in Nineteenth-Century Ireland* (Manchester: Manchester University Press, 2014); Garrett Scaife, *From Galaxies to Turbines: Science, Technology and the Parsons Family* (Philadelphia: Institute of Physics, 2000); J.E. Burnett and A.D. Morrison-Low, *Vulgar and Mechanick: The Scientific Instrument Trade in Ireland 1650-1921* (Dublin: Royal Dublin Society, 1989); Patrick A. Wayman, *Dunsink Observatory, 1785-1985: A Bicentennial History* (Dublin: Dublin Institute for Advanced Studies, 1987); J.A. Bennett, *Church, State, and Astronomy in Ireland: Two Hundred Years of Armagh Observatory* (Chicago: University of Chicago Press, 1992); Nicholas Whyte, “Lords of Ether and of Light: The Irish Astronomical Tradition of the Nineteenth Century,” *Irish Review* (1995): 127-141.

<sup>25</sup> There is no shortage of studies of Irish science. For more, see Peter J. Bowler and Nicholas Whyte, *Science and Society in Ireland: The Social Context of Science and Technology in Ireland, 1800-1950* (Belfast: Queen’s University of Belfast, 1997); Richard A. Jarrell, “The Department of Science and Art and the Control of Irish Science, 1853-1905,” *Irish Historical Studies* 23, no. 92 (1983): 330-347; Sean Lysaght, “Themes in the Irish History of Science,” *Irish Review* 19 (1996): 87-97; Nicholas Whyte, *Science, Colonialism and Ireland* (Cork: Cork University Press, 1999); G.T. Wrixon, “Irish Science and Technology: The Changing Role of the Universities,” *The Irish Review* 17 (1995): 118-126.

<sup>26</sup> This term was coined by Kuhn and refers to the regular working out of scientific problems in the era’s current “paradigm.” For more, see Thomas S. Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1970), 35-42.

<sup>27</sup> Julianna Adelman, *Communities of Science in Nineteenth-Century Ireland* (London: Pickering & Chatto, 2009), 5-9.

in Wales by applying her concepts on the cultural role of science. She argues that science served as a form of entertainment in the context of scientific societies and journals, and that new institutions and literature catered to Irish Catholic needs and tastes. Science was promoted by the government in both institutional and popular contexts as a means that could reform Ireland both socially and economically.<sup>28</sup>

This thesis is centred around the cultural aspects of astronomy in a popular context. I will argue that the value of astronomy was expressed in Wales through different cultural settings from that of Britain or Ireland.<sup>29</sup> Lecturers and authors used Welsh myth and folklore to depict astronomy in a way that adhered to specific Welsh interests, particularly the importance of religious devotion and practical education. The Welsh language played a major role in the popularity of astronomy as the rise of the cultural value of science coincided with the invention of Welsh traditions, modern druids, and eisteddfodau.<sup>30</sup>

New studies on popular astronomy need to account for astronomers who considered observing the heavens as a leisure activity. Sociologist Robert Stebbins has put forward the notion of “serious leisure” in his attempt to define the “amateur” in various activities, including astronomy.<sup>31</sup> He defines serious leisure as a means to supersede work in order to find personal fulfilment, identity enhancement, and self-expression. It is, “the systematic pursuit of an amateur, hobbyist, or volunteer activity that is sufficiently substantial and interesting for the participant to find a career there in the acquisition and expression of its special skills and

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<sup>28</sup> Adelman, *Communities of Science*, 1-5.

<sup>29</sup> Adelman’s main question is “what did science mean to Ireland?” and she examines the role of different institutions and individuals from the years 1840 to 1880. My work follows a similar path in regard to how astronomy was valued and practiced in Wales, albeit with a focus on popular efforts rather than governmental ones and within a broader timeframe. Adelman, 2.

<sup>30</sup> Astronomy was linked with these traditions, as we will see in chapter one. The invention of Welsh traditions owed its foundation to the proto-romantic period in the late eighteenth and early nineteenth centuries. Phillip Jenkins, *A History of Modern Wales, 1536-1990* (London: Longman, 1992), 58.

<sup>31</sup> Stebbins, *Amateurs, Professionals, and Serious Leisure*, xi-xiv.

knowledge.”<sup>32</sup> Astronomers in Wales created an astronomical community by engaging in serious, rather than casual, leisure. Individuals actively chose to pursue astronomy; it is important to consider how astronomy contributed to an individual’s own well-being and to the life of their community. This community was a diverse assortment of individuals, institutions, instruments, and practices that represented practitioners’ different levels of interest and involvement. To expand on the historiography of British astronomy, this thesis examines how astronomers and their audiences produced and consumed astronomical knowledge in accordance with Welsh cultural norms.

### Science in Wales

The nineteenth century was a major transitional period for the development of a modern Welsh identity which paralleled new initiatives in science. Welsh historians have focused on the cultural, political, religious and social movements in Wales during the century with relatively little attention paid to its scientific history.<sup>33</sup> The available work, however, does argue that the history of science in Wales corresponded with developments in industry, education, and literature in the nineteenth century.<sup>34</sup> Louise Miskell has studied the history of science in

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<sup>32</sup> Stebbins notes that serious leisure is within a category of “leisure, free time, spare time, uncommitted time, discretionary time, [and] choosing time.” The key, according to Stebbins, is that serious leisure develops a “unique ethos” where a broad subculture develops through a local group’s special beliefs, norms, events, values, traditions, moral principles, and performance standards. In their own social worlds, they become “amorphous, diffuse constellations of actors, organizations, events, and practices which have coalesced into spheres of interest and involvement for participants [and in which] it is likely that a powerful centralized authority structure does not exist.” Stebbins, 3-8.

<sup>33</sup> For more on Welsh history in the nineteenth century, see Jeremy Black, *A New History of Wales* (Stroud: Sutton, 2000), 141-180; John Davies, *A History of Wales* (London: Penguin, 2007), 310-493; David Gareth Evans, *A History of Wales, 1815-1906* (Cardiff: University of Wales Press, 1989); Geraint H. Jenkins, *A Concise History of Wales* (Cambridge: Cambridge University Press, 2007), 173-226; Matthew Cragoe, *Culture, Politics, and National Identity in Wales 1832-1886* (Oxford: Oxford University Press, 2004).

<sup>34</sup> For more on the development of education in Wales, see Gareth Elwyn Jones, *A History of Education in Wales* (Cardiff: University of Wales Press, 2003), 25-74; Robert Smith, *Schools, Politics and Society: Elementary Education in Wales, 1870-1902* (Cardiff: University of Wales Press, 1999); Gwyneth Tyson Roberts, *The Language of the Blue Books: The Perfect Instrument of Empire* (Cardiff: University of Wales Press, 1998), 73-206. For more

Swansea and the role of an urban, scientific institution that was used to enhance the town's status and identity.<sup>35</sup> R. Elwyn Hughes has examined scientific publishing in Wales.<sup>36</sup> Iwan Rhys Morus' most recent work on William Robert Grove is a sign of the positive direction in which the history of Welsh science is moving. Morus discusses Grove's position as a Welshman and how his Welsh identity was utilized and portrayed in different ways.<sup>37</sup> Morus has questioned whether defining men of science in Wales as "Welsh" is an accurate identifier. He stresses the importance of what it meant to be "Welsh" and how that identity could shift depending on location and occasion.<sup>38</sup> I argue that scientific practitioners can be "Welsh" if they used the Welsh language, perceived themselves as part of a distinctly Welsh society, or if they were actively involved in building a Welsh scientific community.

There has been very little work done on the development of astronomy in Wales. Lee MacDonald examines the work of Welsh astronomer Isaac Roberts and his role in the development of astrophotography, but MacDonald does not examine Roberts' Welsh context.<sup>39</sup> Likewise, the work of Welsh-born Alfred Russell Wallace has received attention, with particular focus given to his views on the existence of extraterrestrial life, but Wallace did not exhibit any distinctive Welsh identity.<sup>40</sup> Mary Brück discusses the life of Thereza Dillwyn Llewelyn, and

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on the significance of religion in Welsh education, see Glanmor Williams, *Religion, Language, and Nationality in Wales* (Cardiff: University of Wales Press, 1979), 87-108, 200-216.

<sup>35</sup> Louise Miskell, "The Making of a New 'Welsh Metropolis': Science, Leisure and Industry in Early Nineteenth-Century Swansea," *The Historical Association* (2003): 32-54. For more on Swansea in the nineteenth century, see Ralph A. Griffiths, *The City of Swansea: Challenges & Change* (Wolfeboro Falls: Sutton, 1991).

<sup>36</sup> R. Elwyn Hughes, "The Welsh Language in Technology and Science 1800-1914," in *The Welsh Language and Its Social Domains, 1801-1911*, ed. Geraint Jenkins (Cardiff: University of Wales Press, 2000), 405-430.

<sup>37</sup> Iwan Rhys Morus, *William Robert Grove: Victorian Gentleman of Science* (Cardiff: University of Wales Press, 2017), 3-6.

<sup>38</sup> Morus, *William Robert Grove*, 5.

<sup>39</sup> Lee focuses on Roberts' role in astrophotography and his position as an "amateur" in relation to his clashes with American astronomer Edward Emerson Barnard. For more, see Lee T. MacDonald, "Isaac Roberts, E.E. Barnard and the Nebulae," *Journal for the History of Astronomy* 41, no. 2 (2010): 239-259.

<sup>40</sup> Robert Smith discusses Wallace's views on the extraterrestrial life debate. For more, see Robert W. Smith, "Alfred Russell Wallace, Extraterrestrial Life, Mars, and the Nature of the Universe," *Victorian Review* 41, no. 2 (2015): 49-69. For more on Wallace more generally, and his work on evolution, see Charles H. Smith and George

John Birks details the construction and operation of her observatory at Penllergare.<sup>41</sup> The recent study on astronomy by Bryn Jones provides a broad overview of the history of astronomy in Wales and presents a multitude of sources for further research.<sup>42</sup> Jones' survey is nevertheless an excellent starting point for scholars aiming to do more in-depth research on some of the individuals and groups he has listed.

## Sources

I use a multitude of English- and Welsh-language sources that have not been examined previously to analyze the development of astronomy and its cultural value in Welsh society in the nineteenth century. Newspapers, journals, and periodicals form a significant portion of my primary source base.<sup>43</sup> They inform on lecturers, astronomers, science societies, astronomical publications, and often serve as the only surviving material on many Welsh astronomers' endeavours. Newspapers are a source base that provides excellent insight into how astronomy was portrayed in public culture, as well as how audiences experienced and reacted to astronomy. Not only do they serve as trackers of different lecturers' tours, but they also describe audiences' responses to lectures, publications, and contemporary debates. Additionally, various lecture notes

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Beccaloni, *Natural Selection and Beyond: The Intellectual Legacy of Alfred Russel Wallace* (Oxford: Oxford University Press, 2008).

<sup>41</sup> Brück, *Women in Early British and Irish Astronomy*, 115-123; John L. Birks, "The Penllergare Observatory," *Antiquarian Astronomer* (2005): 3-8.

<sup>42</sup> Bryn Jones, "A History of Astronomy in Wales," accessed February 14, 2018, <http://www.jonesbryn.plus.com/wastronhist/>.

<sup>43</sup> The National Library of Wales has catalogued 15 million newspaper articles from the nineteenth century and have just begun a catalogue of over 450 periodicals and journals. The journals database features a longer time frame, with articles published between 1735 and 2007, and provides a new source base for further research into the history of science in Wales. Their newspaper database features publications between 1804 and 1919. "Welsh Newspapers Online," The National Library of Wales, accessed February 19, 2018, <http://newspapers.library.wales>; "Welsh Journals," The National Library of Wales, accessed February 23, 2018, <https://journals.library.wales>.

have survived that give insight into the content of astronomical lectures and what audiences were learning from lecturers.<sup>44</sup>

I utilize many published books, manuscripts, notes, letter, and diaries. Several works on astronomy have survived that give insight into the content of publications and lectures. Robert Roberts' *Daearyddiaeth* (1816) and *Seryddiaeth* (1830) serve as two of the earliest Welsh-language publications that discuss astronomy.<sup>45</sup> Roberts' publications were followed by works by John William Thomas, Eleazar Roberts, Arthur Mee, and others that have previously been poorly covered in the existing literature. Edward Mills' *Darluniadur Anianyddol* (1850) was reported by Silas Evans as the first Welsh-language book devoted solely to astronomy.<sup>46</sup> I have also used the diaries of Thereza Dillwyn Llewelyn and Arthur Mee, two of Wales' most significant astronomers in the century. Their diary entries give insight into their own perceptions of their role and work in Wales.

Wales serves as a unique case study to examine the development of science in an area far from the centre of activities in London, Dublin, Oxford, and Cambridge. Overall, the changing content of publications reveals how the cultural value of astronomy expanded during the century and was shaped by Welsh contexts. An analysis of astronomy in Wales requires both English- and Welsh-language sources to gain a clear understanding of what science meant to people in Wales.

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<sup>44</sup> These notes have survived through the microfiche collections of the National Library of Wales, including notes taken by Evan Davies on astronomy and poetry, and John Price's notes from different lectures performed in 1844 and 1845. Papers of Evan Davies ('Myfyr Morganwg'), 1840-1860, *Cardiff MSS on Microfilm*, National Library of Wales, reel 2.949; Scientific Notes, 1844-1845, *Cardiff MSS on Microfilm*, National Library of Wales, reel 1.442.

<sup>45</sup> Robert Roberts, *Daearyddiaeth: yn rhoddi hanes am yr amrywiol wledydd, teyrnasoedd ac ardaloedd y sydd yn Ewrop, Asia, Affrica ac America* (Caerlleon: J. Fletcher, 1816); Robert Roberts, *Seryddiaeth, neu Lyfr gwybodaeth, yn dangos rheoliad y planedau ar bersonau dynion: ac hefyd esiamplau pa fodd I'w trin: wedi ei gasglu o hen ysgrifeniadau Cymreig, gyda pheth o'r Saesonaeg* (Llanrwst: John Jones, 1830).

<sup>46</sup> J. Silas Evans, *Seryddiaeth a Seryddwr* (Cardiff: William Lewis, 1923), 271; Edward Mills, *Y Darluniadur Anianyddol, sef eglurhad ar egwyddorion seryddiaeth, daearyddiaeth, daeareg, &c.* (Llanidloes: Richard Mills, 1850).

## Chapter Outline

In this thesis I will cover the period from 1804 to 1914. 1804 is significant for several reasons: the first Welsh-language scientific periodical, *Y Greal*, was published; the Welsh newspaper the *Cambrian* was established by Robert Roberts and featured articles on astronomical lectures and research, and new advertisements for private academies and astronomical textbooks were released. The Astronomical Society of Wales was disbanded in 1914 with the outbreak of World War I and serves as the end point for this thesis.

In my first chapter I argue that Sunday schools, public lectures, orreries, and invocations of the sublime played a crucial role in scientific education. The nineteenth century was the golden age of the lecture. Public lectures acted as a means for mass communication of ideas, and they doubled as a form of entertainment and a pious activity.<sup>47</sup> Performances were often dependent on spectacle and lecturers used aesthetic codes to captivate their audiences. Lecturers were perceived by audiences as legitimate authorities on science who were valued for their public role as educators. They invoked aspects of the sublime to enthrall audiences with new astronomical phenomena. Lecturers functioned in different cultural spaces and offered a new medium of scientific education. They were operating in a “cultural marketplace,” competing with a range of other attractions and entertainment. Audiences consciously chose to attend lectures.<sup>48</sup> The notion of marketplace will also allow me to discuss the perspectives and experiences of both the producers (lecturers) and consumers (their audiences) of astronomical knowledge.

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<sup>47</sup> Chapman, *The Victorian Amateur Astronomer*, 165.

<sup>48</sup> The notion of a “cultural marketplace” was first put forward by Aileen Fyfe and Bernard Lightman. They argue that the framework built around “professional science” has distorted our understanding of the nineteenth century. They aim to expand this framework and incorporate “the site” into studies on the role of science during this century that saw the gradual emergence of a modern and robust definition of scientific practice. Fyfe and Lightman, “Introduction,” in *Science in the Marketplace*, 1-22, 2-5.

Successful lecturers attracted large audiences by producing a unique fusion of education and entertainment. The experience of astronomy differed greatly depending on where it was performed and to whom.<sup>49</sup> What science meant and how it was understood by performers and audiences alike was dependent on the performers themselves, their location, visual tools, language, and their ability to create a spectacle. To fully understand the significance of astronomy during this period, it is also important to consider not just the lecturers and their audiences, but also the spaces in which they performed. Theatres, town halls, churches, school rooms, and chapels became *sites* of astronomical learning, and gained different characteristics as perceived by various audiences.<sup>50</sup> The location of lectures turned these spaces into temporary scientific centres and connected astronomy with broader Welsh cultural expressions that were experienced within these same spaces.

In the second chapter, I argue that astronomy was practiced for both personal and social gains as a serious leisure activity. Astronomers in Wales created their own network through the work of prominent figures in Welsh society including John Dillwyn Llewelyn, Thereza Dillwyn Llewelyn, John William Thomas, John Jones, Robert Roberts, and Arthur Mee. The emerging Welsh astronomical network, connected by local scientific societies, worked to connect with the scientific centre in England by the late decades of the century. The astronomical community in Wales shared a close connection with local scientific societies, and later resulted in the creation of the Astronomical Society of Wales. Numerous publications depicted astronomy as a poetic cultural tradition and a druidic pursuit. Astronomers became a recognized cultural authority by their audiences through the power of observatories and telescopes. Astronomers exercised an element of autonomy; they pursued astronomy at their own discretion, participated in scientific

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<sup>49</sup> Morus, *William Robert Grove*, 27.

<sup>50</sup> Fyfe and Lightman, "Introduction," 4.



societies, and published what they wished. To understand Welsh individuals involved in astronomy we must understand the changing contours of the developing scientific culture through and within which these men and women operated.

In my third chapter I argue that scientific publishing in Wales was built around the themes of education and cultural expression. Hughes argues that the success of science in Wales was hindered by three dominant factors: the polarized and hierarchical nature of the population, the Bible-centric nature of Welsh society, and the difficulties associated with scientific terminology and vocabulary. He claims that the division between Welsh and English is more apparent in the world of science than any other field of knowledge because of a lack of Welsh-language literature.<sup>51</sup> However, the question of Welsh scientific literature is much more complicated than cultural norms and vocabulary problems. Rather, Welsh people utilized science in a way that strengthened their religious convictions, while they defined new methods when writing and discussing science. Hughes asserts that science in the Welsh language during the nineteenth century was an “isolated and temporary phenomenon,” where the only notable achievement was “the tenacity of the attempt” rather than any remarkable accomplishments.<sup>52</sup> But the relatively low number of Welsh-language astronomical texts does not reveal the complete picture of the popularity of astronomy in Wales. The lack of literature does not mean no one valued astronomy.<sup>53</sup> Instead, most publications took the form of periodicals, which allowed for cheaper printing and a wider distribution.

In the ‘Conclusion’, I argue that the multifaceted development and impact of astronomy in Wales was influenced by Welsh cultural values. Each chapter follows the major recurring

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<sup>51</sup> Hughes, “The Welsh Language in Technology and Science,” 420-421.

<sup>52</sup> Hughes, 430.

<sup>53</sup> Evans, *Seryddiaeth a Seryddwr*, 261.

themes of religion, education, and cultural expression and this approach enables us to see that astronomy was entrenched as a culturally significant practice by the turn of the nineteenth century. Public astronomy developed first with lectures and Sunday school education, then through new Welsh-language translations and publications, and last with the establishment of the Astronomical Society of Wales. Astronomy, in fact, formed an intrinsic part of popular culture in nineteenth-century Wales. The cultural authority of astronomy became increasingly depicted in shows, lectures, sermons, poems, and publications where astronomers were portrayed as Welsh cultural heroes. Visual tools, printed material, and poetic imagination all played crucial roles that enabled astronomy to flourish. I assert that astronomy was depicted by lecturers, astronomers, and publishers as a central facet of Welsh culture and became a valuable aspect of Welsh society during the nineteenth century. Astronomy functioned to suit diverse cultural, religious, and social goals, as different audiences produced and consumed astronomical knowledge that transformed astronomy into a science that was truly fit for the chapel.

## Chapter 1 “grandfathers of the Ether”: Lecturing, Education, and Popular Science

In 1844, the *Pembrokeshire Herald* noted that the country “swarms with lecturers on astronomy,” but that many lecturers left their audiences confused and uninformed. Hundreds of lecture attendees may crowd a lecture hall, but if the lecturer was not satisfactory, they would learn nothing; instead, audiences would just be left “wondering what it is all about.” The newspaper pointed out that half of lecturers had “snatched their trifle of knowledge from a sixpenny pamphlet, and depend on their deficiency in this respect being supplied by the brilliant colours of a piece of painted glass.”<sup>54</sup> Visual aids alone did not make a lecture successful, but rather had to serve as one element of a lecturer’s performance. Eloquence of language was just as crucial. If a lecturer was boring or plain, he risked losing his audience.<sup>55</sup> In order to educate and entertain an audience, a lecturer needed to deliver a comprehensive performance that combined visual tools, effective language, and invoke feelings of sublimity to truly capture an audience.

Lightman has pointed out the importance of going beyond print culture when discussing popular science in nineteenth-century Britain. Oral culture and the culture of display were equally as important to print media and must be considered alongside publications to fully understand popular science during this period.<sup>56</sup> Lectures were used to disseminate astronomical knowledge to Welsh audiences, solidify the connections between science and religion, and express the cultural authority of astronomy. However, scientific education was not limited solely to public lectures. Sunday schools and private academies offered lessons on astronomy that reached multiple audiences that included men, women, and children. The first lectures in the

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<sup>54</sup> “Lecture,” *Pembrokeshire Herald and General Advertiser*, June 21, 1844, <http://newspapers.library.wales/view/3051717/3051719/12>.

<sup>55</sup> If a lecturer depended solely on his visual aids, his audience may learn nothing from his performance and leave the lecture simply stating that, “the pictures were pretty.” “Lecture.”

<sup>56</sup> Lightman, *Victorian Popularizers of Science*, 17.

nineteenth century were performed by travelling Englishmen, such as R.E. Lloyd and Franklin. By the mid-century, local Welsh lecturers gained prominence because they appealed to large Welsh-speaking audiences. I argue that lecturers' role in the development of astronomy in Wales was based on two main tools: the sublime and the orrery.

## Lectures

Astronomy was an extremely popular pursuit because of its strong connections to Welsh culture and the growing communities of individuals in Wales with astronomical interests. Observing the heavens was portrayed as a religious activity and lecturers played a major role in establishing and strengthening the astronomer's image as a pious natural theologian. A scientific lecturing empire was first established in London during the first half of the century and lecturers began to travel throughout Britain.<sup>57</sup> Lecturers embarked on extensive tours more often than writing books because lecturing was a better source of income.<sup>58</sup>

The theme of practical, useful scientific learning made astronomy a popular subject. However, the potential success of a lecture depended on the language of the audience and the lecturer, his visual tools, and successful invocations of the sublime. Lectures were hailed by newspapers for their morally uplifting effect on audiences and perceived as a socially beneficial form of entertainment.<sup>59</sup> English-language written material and English-speaking performers were more available than those in Welsh, but the lack of Welsh-language astronomical endeavours did not mean that astronomy was unpopular in Welsh-speaking audiences.

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<sup>57</sup> For more on scientific lecturing in London, see J.N. Hays, "The London Lecturing Empire, 1800-50," in *Metropolis and Province: Science in British Culture, 1780-1850*, ed. Ian Inkster and Jack Morrell (London: Hutchinson & Co., 1983), 91-119.

<sup>58</sup> Lightman, "Lecturing in the Spatial Economy of Science," in *Science in the Marketplace*, 97-134, 102.

<sup>59</sup> Golinski, "Sublime Astronomy," 151.

As early as 1804, astronomy was advertised in newspapers as a primary teachable subject to large audiences. One example is “Levitt’s Lessons on Astronomy and Geography,” which advertised educational lectures to all members of the public.<sup>60</sup> Many early lectures were performed by Englishmen commencing tours in Wales. Audiences were aware of astronomers’ work across Britain as newspapers informed readers on both the work of incoming lecturers. Debates on astronomical subjects were reported from Cambridge, such as Reverend S. Vince Plumian’s “A Confutation of Atheism.” This work from 1807 was a series of four lectures performed at the University of Cambridge that were later published as a small volume for purchase.<sup>61</sup> The *Cambrian* described Plumian’s “discourses” as “a short and familiar introduction to the science of Astronomy, comprising a perspicuous description of the Solar and Lunar Systems, comprehending the Sun, Moon, Planets, and Comets - the motions of the Heavenly Bodies - Eclipses - Seasons - Tides, &c. &c.”<sup>62</sup> That Vince’s lectures were a “familiar introduction” implies that basic knowledge of astronomy was generally well-known.

Religious themes pervaded astronomical lectures as Christian belief was the cause most promoted by lecturers.<sup>63</sup> Often, newspapers promoted natural philosophical motivations for pursuing astronomy, adhering to the existence of a Creator and the duty of the astronomical observer to “trace the *power, wisdom, and goodness* of the Creator: his [*sic*] power in its formation; his wisdom in the simplicity of the means to produce the ends; and his goodness in making those ends subservient to our enjoyment.” Training in astronomy was thus undertaken for “further enjoyment of him.”<sup>64</sup> Vince was one of numerous lecturers who were espoused in

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<sup>60</sup> “Advertising,” *Cambrian*, November 15, 1806, <http://newspapers.library.wales/view/3321355/3321356/1>.

<sup>61</sup> The significance of astronomical publications will be discussed in chapter three.

<sup>62</sup> “A Confutation of Atheism,” *Cambrian*, December 19, 1807. <http://newspapers.library.wales/view/3321605/3321609/15>.

<sup>63</sup> Chapman, *The Victorian Amateur Astronomer*, 169.

<sup>64</sup> “A Confutation of Atheism.”

Wales among a group that included R.E. Lloyd, Robert Goodacre, J. Barclay, M.M. Rogers, Franklin, Robert Roberts, and others. Astronomy was pursued primarily as a religious activity, and lecturers who aligned with natural theological principles were promoted in the Welsh press.

### “Engines of the Sublime”: Orreries and Visual Tools

Orreries were the most important visual tool for a nineteenth-century astronomical lecturer, and they often formed the focal point of a performance. Henry King defines an orrery among a grouping of “geared astronomical mechanisms.” This group is divided into two subsections, one consisting of astronomical clocks, and the other “Planetary machines, or three-dimensional models that represent the relative motions and positions of the planets... They are powered by hand or by spring- or weight-driven clockwork and, in modern times by electric motors.”<sup>65</sup> The first orreries, made in the seventeenth and eighteenth centuries, were small and only effective when used to educate groups of less than ten people.



Figure 3.  
Joseph Wright of Derby, *A Philosopher Lecturing on the Orrery*, Derby Museum and Art Gallery, 1766. Reproduced from Henry King, *Geared to the Stars: The Evolution of Planetariums, Orreries, and Astronomical Clocks* (Toronto: University of Toronto Press, 1978), 166.

<sup>65</sup> Henry C. King, *Geared to the Stars: The Evolution of Planetariums, Orreries, and Astronomical Clocks* (Toronto: University of Toronto Press, 1978), xiii.

By the end of the eighteenth century, lecturers began to introduce larger, simpler versions of the orrery, but the details of their construction remain vague. The first inventor of a large orrery, called an “eidouranion,” was Adam Walker in the late eighteenth century.<sup>66</sup> Walker’s “machine” was described by newspapers and audience members as being mounted vertically to show the motions of the planets using illuminated globes that moved without any visible supports. King suggests that the eidouranion was a modified version of Christian Huygens’ clock-face orrery from the seventeenth century.<sup>67</sup> Such a large construction meant that the eidouranion would have to be dismantled, transported to the next lecture location, and reassembled.<sup>68</sup> Another possibility is that the eidouranion was simply a magic lantern.<sup>69</sup>

The orrery became a crucial tool through which lecturers displayed astronomy in the awe-inspiring visual language of the sublime. Edmund Burke and Immanuel Kant were two of the first writers to discuss the notion of the sublime. For Burke, terror was the central feeling of the sublime, an incredible or awesome emotion.<sup>70</sup> For Kant, the sublime arose out of a tension between sense and reason, and it demonstrated the potential of the human mind to conceive

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<sup>66</sup> Walker’s lecturing dynasty began in the 1760s and continued into the 1830s. His large eidouranion was first reported in the late 1770s when he entered the London market. Jan Golinski, “Sublime Astronomy,” 140.

<sup>67</sup> Huygens’ orrery used circular plates rotating in grooves to represent the planets’ orbits. Holes were cut in the plates, filled with glass, and illuminated from behind. The illumination showed the movements of the planets and moons but hid the rest of the apparatus, creating the illusion that the planets moved without supports. King, *Geared to the Stars*, 310.

<sup>68</sup> If the orrery was in the model of Huygens’, it would have had to have been made out of metal, which would be incredibly heavy. Golinski details an alternative made out of wood. This model aligned more with a skeletal framework than a large clock face. One example from the 1840s is a “vertical tellurian,” which depicted the orbit of the earth around the sun that could be 40 feet high. Images of the vertical tellurian closely resembled Walker’s eidouranion being shown at the English opera house (Figure 4). Golinski, “Sublime Astronomy,” 142-145.

<sup>69</sup> Historians of the magic lantern have suggested this possibility. Magic lanterns have existed since the seventeenth century, and worked by projecting scenes from behind a translucent screen that stood between the audience and the projector. The translucent screen could be a sheet of oiled cloth on a frame. However, Golinski argues that the descriptions of the eidouranion make it clear that the planets and moon were in motion. For more on magic lanterns more generally, see Richard Crangle, Mervyn Heard, and Ine Van Dooren, ed. *Realms of Light: Uses and Perceptions of the Magic Lantern from the 17<sup>th</sup> to the 21<sup>st</sup> Century* (London: Magic Lantern Society, 2005). Also cited in Golinski, 144.

<sup>70</sup> Edmund Burke, *A Philosophical Enquiry into the Origin of Our Ideas of the Sublime and Beautiful*, (London: J. Dodsley, 1782), 13-14, 41-43.

concepts far beyond humanity's perceptual limitations.<sup>71</sup> The emergence of the orrery represented a powerful new technology and a novel way to display astronomical phenomena. Lecturers conveyed a sense of awe and grandeur that both overwhelmed their audience's imaginations and brought them to understand and comprehend what they were witnessing. The sublime was not merely a social construction, but rather a unique encounter with reality.<sup>72</sup> In Wales, notions of the sublime were associated with the landscapes of Snowdonia and coincided with the explosion of aesthetic tourism during the nineteenth century.<sup>73</sup> Massive orreries in the nineteenth century attracted diverse audiences and truly became the "engines of the sublime."<sup>74</sup>

Lecturers from outside Wales were popular as early as 1808. R.E. Lloyd, from London, lectured to the "Nobility and Gentry" of South Wales, which included both women and men. Lloyd's astronomical lectures were illustrated by "the new dioastrodoxon, or Grand Transparent Orrery." This orrery was reportedly 21-feet in diameter and cost up to 500 guineas to construct. Lloyd's orrery stood vertically in front of spectators, similar to Walker's eidouranion, and likely illuminated its glass globes from behind. Audience members noted that its globes were so large that even the smallest details could be seen from the back row of a theatre.<sup>75</sup> His transparent orrery showed four different scenes. First, a painted glass globe two-feet in diameter rotated and moved around a luminous model of the sun (with sunspots included) to show the causes and nature of the seasons. Second, Lloyd detailed eclipses and eclipse limits. Third, he showed "the

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<sup>71</sup> Kessler, *Picturing the Cosmos*, 16.

<sup>72</sup> Nye, *American Technological Sublime*, xiii-xv.

<sup>73</sup> For more on the sublime in tourism in Wales, see Malcolm Andrews, *The Search for the Picturesque: Landscape Aesthetic and Tourism in Britain, 1760-1800* (Stanford: Stanford University Press, 1989), 111-131; Brian Hudson, "Tourism in Burrow's 'Wild Wales,'" *Geography* 86, no. 1 (2001): 1-10; Shawna Lichtenwalner, *Claiming Cambria: Invoking the Welsh in the Romantic Era* (Newark: University of Delaware Press, 2008), 105-112. For more on the significance of the sublime in Snowdonia, north Wales, see Simon Bainbridge, "Romantic Writers and Mountaineering," *Romanticism* 18, no. 1 (2012): 1-15; Simon Bainbridge, "Writing from 'The Perilous Ridge': Romanticism and the Invention of Rock Climbing," *Romanticism* 19, no. 3 (2013): 246-260.

<sup>74</sup> Robert W. Smith coined this term.

<sup>75</sup> King, *Geared to the Stars*, 310.



whole Copernican system, with every planet and satellite in diurnal and annual motion.” And last, he displayed the causes of the tides.<sup>76</sup> Lloyd was operating at the same time as Adam Walker and his sons, and through their orreries they engaged in active competition. Astronomical lecturers competed for the same audiences, and the quality of one’s orrery and other visual tools played a crucial role in determining a lecturer’s success.



Figure 4.  
Walker’s exhibition of the Eidouranian at the English Opera House, Strand, March 21, 1817, Victoria and Albert Museum. Reproduced from Henry King, *Geared to the Stars: The Evolution of Planetariums, Orreries, and Astronomical Clocks* (Toronto: University of Toronto Press, 1978), 315.

Lloyd’s orrery was key to his popularity in Wales. Attendees marveled at his illustrative tools, “the whole for magnitude of scale, grandeur of design, and varied beauty, infinitely excels any thing [*sic*] of the kind in this, or perhaps in any other country.”<sup>77</sup> Lloyd’s lectures appealed

<sup>76</sup> King, 315.

<sup>77</sup> “Never Displayed in the Principality of Wales,” *Cambrian*, June 25, 1808, <http://newspapers.library.wales/view/3321735/3321736/1>.

greatly to both men and women, and both were welcomed as audience members. Specific attention was paid to the interest of women, as one report on a Lloyd lecture noted:

It is presumed that the present offer will be found truly grateful, not only to the Ladies, whose interests have been eminently consulted, but also the Gentleman, the Scholar, and the Man of Business, being elucidated by an Apparatus at once simple, beautiful, and convincing, thereby rendering Astronomical Truths so perspicuous, that even those have not previously made it an object of study, may instantly acquire ideas of the harmony and economy of celestial motion ... a single view of the instrument will convince even the Sceptic of its infinite superiority, in familiarizing the sublime Science of Astronomy.<sup>78</sup>

The teaching power of orreries continued through the century as they increased in size and complexity. According to newspaper reports, eloquent uses of language were combined with the sublime spectacle of the orrery to create a unique experience that displayed new visions of the universe to audiences. Frequent uses of terms like “sublime” evoked emotions from the audience, and associated advertisements depicted shows as powerful spectacles that communicated the awesome magnitude of the universe.<sup>79</sup> Lecture audiences were transformed into cosmic voyagers who traveled to astronomical destinations such as the moon, planets, and other galaxies, to discover and experience new and awe-inspiring wonders from different worlds.

Details of upcoming lectures and a lecturer’s planned tour were advertised in newspapers weeks before scheduled performances. Two months after the start of his tour, Lloyd’s apparatus was again marketed when he reached Swansea in early September 1808. Lloyd was noted as the “only Legitimate Proprietor of the Transparent Orrery.”<sup>80</sup> Lloyd’s tour finished in December 1808, with his last show at the Swansea theatre. The *Cambrian* described the lecture, “[t]he whole combining magnitude, mechanism, and varied beauty, hitherto unknown in the annals of

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<sup>78</sup> “Never Displayed in the Principality of Wales.”

<sup>79</sup> Golinski, “Sublime Astronomy,” 137.

<sup>80</sup> “Advertising,” *Cambrian*, September 3, 1808, <http://newspapers.library.wales/view/3321785/3321788/8>.

Astronomy.”<sup>81</sup> Lloyd was one of the first of a long list of astronomical lecturers who toured throughout Wales with immense success. Lloyd toured through England as well, though his lectures did not attract nearly the same level of attention.

Lloyd’s lectures were reported on two years later during a tour through England. While Lloyd was immensely popular during his tour of South Wales in 1808, his visit to Stafford in 1810 was very poorly attended and not successful.<sup>82</sup> His lectures did not fare well in Edinburgh, either. In 1820, after repeating the same lecture four times, Lloyd reportedly received so much abuse, with catcalls and objects thrown at him that he swore he would never visit the city again.<sup>83</sup> A successful lecture in one town did not mean that every lecture would be popular. Different audiences held differing expectations and standards for a lecture.

But despite Lloyd’s failed lectures in England and Scotland, he returned to Wales in 1820. The theatre, normally closed during lent, was opened for two days for Lloyd’s return.<sup>84</sup> It was noted as “positively the last time in this town” that attendees would be able to see his sublime orrery. Lloyd was noted as the “Annual Lent Astronomical Lecturer” and he was to give his “course of astronomical lectures, illustrated by the Dioastrodoxon, or, Grand Transparent Orrery.” His lectures were promoted as displaying “Scenery and Decorations annually displayed in London, on a scale of grandeur and magnificence never yet witnessed in this Town; the whole forming the desideration of astronomical beauty and intelligence.”<sup>85</sup> Lloyd was further praised:

The facility of comprehension which Mr. Lloyd’s magnificent apparatus affords, of the most profound and intricate phenomena of Astronomy, has, with justice, rendered his Lectures the most attractive as well as gratifying source of philosophical inquiry. Mr. Lloyd’s luminous dissertations of the course of

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<sup>81</sup> “Advertising,” *Cambrian*, December 3, 1808, <http://newspapers.library.wales/view/3321850/3321853/10>.

<sup>82</sup> “Swansea: Criticism and Philosophy,” *Cambrian*, June 30, 1810, <http://newspapers.library.wales/view/3322255/3322258/10>.

<sup>83</sup> King, *Geared to the Stars*, 317.

<sup>84</sup> “Theatre, Swansea,” *Cambrian*, September 9, 1820, <http://newspapers.library.wales/view/3324710/3324713/11>.

<sup>85</sup> “Theatre, Swansea.”

celestial bodies, theory of eclipses, comets, &c. are so admirably illustrated by beautiful and unique machinery, that, while the most enlightened will be delighted with the superior clearness of his arrangement, the most uninformed cannot fail at once to perceive the real causes of those astonishing effects which were for ages equally misrepresented by the cunning of bigotry and the credulity of ignorance. To the great proportion of the juvenile branches of society a greater treat cannot be afforded, than this noble display of pictorial and mechanical excellence, an aid of mental research.<sup>86</sup>

Orreries served as a lecturer's primary tool for education and entertainment. However, other visual aids were used in conjunction with transparent orreries. One example is a Mr. Maillew, whose astronomical lectures included the "illustrative assistance of an excellent Astronomical, &c. Apparatus" such as, "tellurian, planetarium, astronomical phantasmagoria, quadrants, telescopes... lunar and solar, &c. armillary spheres, magnets, set of mechanical powers, optical machine for prints, &c. ... which have been procured at the expence [*sic*] of upwards of £100."<sup>87</sup> Through employing "engines of the sublime" lecturers drew large audiences and displayed the magnificence of the heavens.

Romantic notions of astronomy connected astronomy with a growing public interest in scientific education. Lecturers used tools and language together to translate astronomical discoveries into easy, understandable terms. The immense popularity of orreries, magic lanterns, and other visual aids in Wales demonstrates the pervasiveness of astronomy and how these visual aids brought scientific lectures to the forefront in the public. Lloyd's orrery was one of the earliest in an emerging tradition of astronomical lecturers in Wales who used orreries to educate and entertain. Lloyd himself was from London, but we will see that by mid-century lecturers from Wales gained prominence for their knowledge of the Welsh language.

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<sup>86</sup> "Theatre, Swansea."

<sup>87</sup> "Eastwood House Academy," *Carmarthen Journal and South Wales Weekly Advertiser*, December 5, 1812, <http://newspapers.library.wales/view/3677029/3677030/3>.

## Lecture Courses

Lecturers in the early decades also taught weekly astronomy courses. These lecturers and their supplementary courses were often advertised in newspapers. One example is Robert Goodacre's lecture courses in the 1820s. He performed introductory lectures on astronomy in the Swansea theatre on Sunday evenings, while also teaching more detailed courses on astronomy on Mondays in the Swansea national school room. His lecture advertisements accompanied notes on the promotion of church and chapel donations.<sup>88</sup> Goodacre's lectures were so popular that after his third lecture on "seasons, climates, &c." he was requested to repeat the lecture the following day. This was in addition to three other popular lectures, namely *Time, the Precession of the Equinoxes, the Starry Heavens, &c.*, *Lunar Astronomy*, and *The Eclipses and Tides*. In total, Goodacre delivered eight different lectures at the Swansea theatre on multiple occasions through the use of numerous visual aids. His aids included a "Horizontal Tellurian, Lunarian, and Eclipsareon... [a] Vertical Transparent Tellurian ... a splendid Transparent Orrery ... a Transparent Planisphere of the Starry Heavens, forty-five feet in circumference," and a "plan of a Universal System, or System of Solar Systems, forty feet in circumference."<sup>89</sup> Goodacre returned on multiple occasions to perform his series of lectures.<sup>90</sup>

Goodacre concluded his lectures by discussing the immense size of the universe. He argued for the existence of thousands of stars within nebulae and compared the solar system to others as "villages dispersed throughout the country." Goodacre's arguments informed Welsh audiences on one of the most discussed topics in astronomy during the century: whether nebulae

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<sup>88</sup> "Theatre, Cardiff," *Cambrian*, November 8, 1828, <http://newspapers.library.wales/view/3326835/3326838/13>.

<sup>89</sup> "Lectures on Astronomy," *Cambrian*, October 25, 1828, <http://newspapers.library.wales/view/3326825/3326828/7>.

<sup>90</sup> "Lectures on Astronomy;" "Lectures on Astronomy," *Cambrian*, November 15, 1828, <http://newspapers.library.wales/view/3326840/3326842/5>.

were a collection of densely packed stars, or a currently evolving solar system as described by Laplace in his nebular hypothesis.<sup>91</sup>

In 1835, seven years after touring Wales, the *Cambrian* noted in its obituaries that Robert Goodacre had passed away on November 25.<sup>92</sup> Goodacre, it reported, was remembered throughout Wales as a talented astronomical lecturer who combined visual spectacle with eloquent language to create a scientific space that allowed for religious debates on life and sublime contemplations of the heavens. However, reports on lectures by a Mr. Goodacre continued after the lecturer's death; it is likely that his son continued to tour. Goodacre the younger continued his father's lectures by arguing for a plurality of worlds: "This assemblage of myriads of firmaments - each firmament composed of millions of suns - and each sun, with its respective system, capable of sustaining millions upon millions of millions of created beings - forms but a mere speck, an all but nothing midst the boundless regions of existence throughout which the Eternal reigns."<sup>93</sup> The Goodacre family's popularity among Welsh men, women, and children, coupled with their views on plurality, suggests that it was a widely discussed topic.

Children's education in astronomy was valued by nineteenth-century Welsh society and there were even lectures geared solely towards children. The *Monmouthshire Merlin* detailed a Mr. Wildsmith's series of lectures for children that were separated from his lectures to adults:

We understand that Mr. Wildsmith, who has been lecturing on the science of astronomy, in this town, during the past week, will deliver a lecture on that sublime and interesting subject, to a juvenile party exclusively. We would recommend parents to avail themselves of this opportunity of affording their offspring an evening's amusement of the most delightful descriptions. As will be

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<sup>91</sup> Lord Rosse was also intensely involved with debates over the nebular hypothesis. His telescope, the Leviathan, helped to finally solve the nebular hypothesis when he concluded that nebulae were merely close stars. For more, see Attis and Mollan, *William Parsons*, 210-270; Simon Schaffer, "The Leviathan of Parsonstown," in *Inscribing Science: Scientific Texts and the Materiality of Communication*, 182-222.

<sup>92</sup> "Family Notices," *Cambrian*, December 5, 1835, <http://newspapers.library.wales/view/3328650/3328653/15>.

<sup>93</sup> "Gleanings," *Cambrian*, January 13, 1838, <http://newspapers.library.wales/view/3329200/3329204/22>.

seen by reference to our advertising columds [*sic*], Mr. W. intends visiting Cardiff in the ensuing week.<sup>94</sup>

The education of children became a significant market for lecturers in addition to their adult crowds. Lecture advertisements often noted that children could attend astronomical lectures for half price, or even for free.<sup>95</sup> Children were a unique audience that represented a potentially new market for astronomical dissemination.

The ability of a lecturer to appeal to children was a marker of their authority as a scientific educator. In 1838, after delivering a lecture to an audience of 200 women, men, and children in Cardiff, Reverend J. Barclay was lauded for “improving the understanding... and suggesting by their accurate delineation, the highest notions of the wisdom and power of the Creator.” Barclay’s lectures were deemed a great success, partly because of “the manner in which a child of nine years of age answered questions from the Bible, and also in Geography, Chronology, and Astronomy.”<sup>96</sup> A lecturer’s ability to appeal to both children and adults was crucial for their success in Wales. Audiences varied greatly in age, and lecturers needed to be versatile in appealing to different levels of knowledge.

A lecturers’ previous tours were important to establish his authority as a quality educator and entertainer. Much like Lloyd, lecturers repeated tours through Wales. One example is a Mr. Keevil, who performed across Britain between 1830 and 1850. He travelled to both north and south Wales to lecture, and one of his magic lantern slides is one of the few nineteenth-century astronomical apparatuses with moving parts to have survived.<sup>97</sup> After his lectures in Holyhead,

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<sup>94</sup> “Astronomy,” *Monmouthshire Merlin*, September 14, 1839, <http://newspapers.library.wales/view/3393015/3393018/25>.

<sup>95</sup> “Lectures on Astronomy,” *Cambrian*, November 15, 1828, <http://newspapers.library.wales/view/3326840/3326842/5>.

<sup>96</sup> “Latest Intelligence,” *Monmouthshire Merlin*, March 17, 1838, <http://newspapers.library.wales/view/3392654/3392657/26>.

<sup>97</sup> The magic lantern slide was reportedly used in 1838 to project an image from behind onto a larger screen. Golinski has examined Keevil’s astronomical slide. The apparatus was ten inches tall and activated with a small



north Wales, an advertisement detailed Keevil's other previous travels in England, and the power of his visual tools:

Demonstrations of the Heavens and the Earth - It will be seen by an advertisement in a previous column that Mr. Keevil, late of Winchester College, F.A.S., purposes giving a lecture on astronomy, on Monday, the 18th instant, at the Theatre, in this town, illustrated by a large planetarium and a panoramic view of the heavens, showing upwards of five thousand objects of universal stellar creation. We find that Mr. Keevil has been lecturing in London, Windsor, and Bristol, to crowded audiences, and we sincerely hope the inhabitants of Cardiff will avail themselves of the opportunity of hearing this talented gentleman on so sublime and interesting a science.<sup>98</sup>



Figure 5.  
Keevil's Magic Lantern slide used in a lecture in 1838. Reproduced from Jan Golinski, "Sublime Astronomy: The Eidouranian of Adam Walker and his Sons," *Huntington Library Quarterly* 80, no. 1 (2017): 147.

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hand crank mechanism. There is also a number on the side of the slide ("No. 6") which suggests that it was part of a series of lantern slides. For more, see Golinski, "Sublime Astronomy," 146-147.

<sup>98</sup> Whether Keevil's "large planetarium" is referring to his magic lantern slides or a different mechanical orrery is unknown, but the mention of showing "upwards of five thousand objects" suggests it was a different apparatus from the surviving lantern slide. "Demonstrations of the Heavens and the Earth," *Cardiff and Merthyr Guardian Glamorgan Monmouth and Brecon Gazette*, April 14, 1849, <http://newspapers.library.wales/view/3089457/3089460/17>.



Lecturers were aware of different audience's needs and expectations. Different social classes responded in different ways to astronomical material, but if they performed well, astronomers visiting working-class communities became celebrities overnight. Visits to working-class institutions, such as Mechanics' Institutes, drew comparisons to the crowd-drawing power on the level of prize fighters and opera singers.<sup>99</sup> The prices of lectures were sometimes a matter of concern for working class audiences. However, lecture advertisements promoted cheap lectures to poorer audiences. One example comes from the *Monmouthshire Merlin* from 1849, where the lectures of a Mr. Hemming were advertised:

On Wednesday last, a lecture on astronomy was delivered in the National School-room, by Mr. Hemming, which, owing to the unfavourable state of the weather, failed to attract a large company. On Friday, Mr. Hemming repeated the lecture, which afforded great satisfaction to the audience; he has since visited Abbey Tintern, where there was a good attendance of the working class, with whom Mr. H. is quite at home; his manner of delivery, assisted by various diagrams, seemed to be properly appreciated by the sons of toil. He is proceeding through Monmouthshire, and there is but little doubt of his success, especially as his terms for admission are very moderate.<sup>100</sup>

Different lecturers adjusted their performances to suit their targeted audiences, but themes of education, natural theology, and spectacle remained consistent among diverse audiences.

M.M. Rogers was advertised as a new astronomical lecturer in 1825. His lectures were geared directly towards the “Nobility and Gentry of Swansea and its Vicinity,” where he aimed to “answer, and *demonstratively refute* the objections which Infidels have pretended to draw from that Science against the truth of Holy Writ.” Rogers’ used an orrery, illustrations, diagrams, and a new microscope during his lectures. His orrery was described as, “indisputably the most powerful and perfect apparatus ever yet constructed! To those, whose highly cultivated minds

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<sup>99</sup> Chapman, *The Victorian Amateur Astronomer*, 166.

<sup>100</sup> “Chepstow,” *Monmouthshire Merlin*, January 6, 1849, <http://newspapers.library.wales/view/3394566/3394569/23>.

delight in observing the beauties of Nature, this superb instrument will open an ample field for wonder and contemplation.”<sup>101</sup> The use of instruments for furthering astronomical knowledge was crucial. Not only were these instruments owned by performers, but advertised as purchasable items by wealthy individuals. The most popular lecturers, such as Lloyd, Goodacre, Keevil, or Rogers, were dependent on their respective visual tools in order to properly and succinctly display astronomical phenomena, but they also needed to successfully incorporate captivating narratives into their performances to create a truly sublime experience.

### **Astronomy and Religion**

Lecturers connected notions of the sublime with religious contemplations of the universe to appeal to Welsh audiences. One lecturer, a Mr. Franklin, became extremely popular because of his adherence to religious convictions and his emphasis on the importance of “engaging the human mind.” A lecturer’s discussions of religion played a significant role in their popularity. Franklin was praised as an eminent lecturer in various newspaper accounts. The *Pembrokeshire Herald* announced his arrival in 1845 as a substantial event for the town:

We are happy to inform our readers that Mr. Franklin, the celebrated lecturer on the science of Astronomy, has arrived in this town, and that he purposes, giving two astronomical lectures in a few days, Mr. Franklin’s fame as a public lecturer has preceded his visit to this place; the public press everywhere speaks highly of his attainments in the sublime science of the heavenly bodies, and his mode of communicating his knowledge to his auditory is said to be particularly pleasing and interesting.<sup>102</sup>

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<sup>101</sup> “Theatre Swansea,” *Cambrian*, April 9, 1825, <http://newspapers.library.wales/view/3325905/3325908/8>.

<sup>102</sup> “The Market Tolls,” *Pembrokeshire Herald and General Advertiser*, January 10, 1845, <http://newspapers.library.wales/view/3051858/3051860/16>.

Franklin illustrated his lectures using a “Grand Transparent Orrery,” similar to the apparatuses of Lloyd and Walker. His audiences often testified to the excellence of his lectures. A pleased audience meant potential future return visits (and profits) for a lecturer.

The crowding of town halls for lectures was noted in newspaper reports on lectures. One newspaper noted that “[t]he place of lecture was completely filled - a circumstance not only gratifying to Mr. F. but affording a pleasing indication that our fellow towns men [*sic*] are not insensible to the attractions of the most sublime study which can engage the human mind.”<sup>103</sup>

Franklin’s lectures were extremely popular because of his religious narratives that espoused God and science, discussing theological concepts on the plurality of worlds and Creation.<sup>104</sup>

Franklin gained much popularity for visiting smaller towns to lecture. Towns often invited astronomical lecturers after hearing of their performances in other communities. The *Welshman* reported on Franklin’s travels to Pontypool and Abersychan:

A very lively interest has been excited here during the present week, in consequence of the delivery of two lectures, by Mr. Franklin, on the interesting and sublime science of astronomy. This gentleman, when at Pontypool, was invited to visit this neighbourhood, and we have all been agreeably surprised in witnessing so large and respectable an audience in so small a place as Abersychan. The highest satisfaction was felt at the clear and interesting manner in which the subject was elucidated. That part of the second lecture referring to the darkness at the crucifixion elicited universal approbation, and must have proved particularly gratifying to the scientific enquirer and the christian [*sic*] philosopher.<sup>105</sup>

Both of Franklin’s lectures were performed in the respective town halls. Focus was given to informing younger audience members, and Franklin himself was described as “a young man.”

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<sup>103</sup> “Lectures on Astronomy,” *Pembrokeshire Herald and General Advertiser*, January 17, 1845, <http://newspapers.library.wales/view/3051863/3051866/23>.

<sup>104</sup> King, *Gearred to the Stars*, 317.

<sup>105</sup> “Abersychan,” *Monmouthshire Merlin*, August 23, 1834, <http://newspapers.library.wales/view/3391507/3391510/17>.

The beauty of his orrery was noted, and both lectures filled the makeshift lecture theatres. Franklin was urged to return and lecture again in the future.<sup>106</sup>

In addition to town halls, lecturers were also welcomed into Welsh chapels. Astronomy lectures became an intrinsic part of chapel activities, especially during Lent, which helped to elevate it as a popular pursuit in Wales. Nonconformist chapels invited lecturers who presented astronomy in ways that confirmed religious convictions. Franklin's popularity was evident through his lectures at chapels. In 1845, the Tabernacle Baptist Chapel in Carmarthen invited Franklin to perform a lecture. The *Welshman* reported that it was "extremely well attended, and gave very great satisfaction. Mr. Franklin let off a large fine balloon in the ground adjoining the chapel, and illustrated his lecture by a handsome orrery."<sup>107</sup> Pairing religious confirmation with astronomical teachings helped astronomy gain popularity, especially as religious sites like chapels became temporary spaces of scientific learning.

### **Sites for Astronomical Knowledge**

Town halls, chapels, theatres, and other spaces were transformed into temporary sites for the consumption of scientific knowledge. Crowded audiences filled school rooms which became a popular site for lecturing. The Grammar school at Abergavenny was transformed when Walker delivered a series of lectures there in 1836. Newspapers reported that the lectures were illustrated using an orrery that was 42 feet in circumference:

within which is displayed the sun in the centre, revolving on his axis, throwing off a flood of light to the earth, the moon and the planets, the whole being surrounded by the signs of the zodiac, and the 'starry firmament' a display, which had a

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<sup>106</sup> "Astronomy," *Welshman*, January 16, 1835, <http://newspapers.library.wales/view/4364116/4364119/13>.

<sup>107</sup> "Carmarthen," *Welshman*, January 3, 1845, <http://newspapers.library.wales/view/4364366/4364369/22>.

successful effect in conveying information and pleasure to the minds of the young people who were present.<sup>108</sup>

Schools became popular sites for lectures. One example is from 1844, when a Mr. Bear gave a “grand entertainment” to Sunday school children in Milford; the room in which he lectured was “filled to suffocation.”<sup>109</sup> Astronomy doubled as a source of income for schools. In Pembroke, Reverend D.L. Pughe gave a series of lectures at the town school, “to a numerous and respectable audience.” All the proceeds of the lectures were given to the institution.<sup>110</sup>

Local scientific societies invited lecturers to educate members. One prominent lecturer at these institutions was Dr. Henderson, a Fellow of the Royal Astronomical Society. At Newport in 1844, Henderson delivered a week’s worth of lectures to “full audiences, who have expressed themselves highly pleased and instructed.”<sup>111</sup> Henderson’s lectures were followed by other scientific talks in the ensuing week. The introduction of scientific discussions at the local society was attributed to the committee of the Newport Mechanics’ Institute, where they catered to “the improving tastes of Newport for valuable instruction and amusements of a pleasing character.”<sup>112</sup> The Neath Philosophical Society stressed the importance of language when it noted that, “[p]erhaps there is no science, so much as astronomy, which requires clearness on the part of the lecturer to render the subject intelligible and interesting, and the crowded and attentive audiences which assembled week after week, bore ample and flattering testimony in this respect to the

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<sup>108</sup> This is very likely Walker’s eidouranian that Golinski examines. The mentioned signs of the zodiac can also be seen in Figure 4. “Latest Intelligence,” *Monmouthshire Merlin*, October 22, 1836, <http://newspapers.library.wales/view/3392309/3392312/19>.

<sup>109</sup> “Lecture,” *Pembrokeshire Herald and General Advertiser*, June 21, 1844, <http://newspapers.library.wales/view/3051717/3051719/12>.

<sup>110</sup> “Pembroke Dock,” *Pembrokeshire Herald and General Advertiser*, March 16, 1849, <http://newspapers.library.wales/view/3052868/3052870/11>.

<sup>111</sup> “Mechanics’ Institute,” *Monmouthshire Merlin*, March 2, 1844, <http://newspapers.library.wales/view/3424776/3424779/21>.

<sup>112</sup> “Mechanics’ Institute.”

talent of the lecturer.”<sup>113</sup> The importance of education was especially emphasized at local scientific societies, where members sought further scientific education.

One lecture given to the Geological and Natural History Society of Holywell by Henderson in 1838 was titled “Elements of an Astro Theological discourse on the Immensity of the Universe &c.” The lecture was reproduced in the *Carnarvon and Denbigh Herald and North and South Wales Independent* for “our readers who have never yet taken into one comprehensive view the wonders of creation in the antagonist scales of infinite extension and minuteness.”<sup>114</sup> Henderson compared different stars and planets to minute images of nature, such as single grains of sand that “differ from each other in figure, that they are adorned with comparatively immense caverns, in which dwell a peculiar and populous race of animated existence!”<sup>115</sup> Key focus was given to understanding the connection between people and the greater universe. As Henderson calls it, “the connection which each has to others in the vast complicated chain in which ourselves are so small a fragment.”<sup>116</sup> Henderson invoked sublime images and comparisons in his lectures to capture audiences. It is the consistent redeployment of the awesome and grandiose feelings associated with the sublime that maintained astronomy’s cultural authority.

Different local societies invited travelling lecturers to discuss astronomy with members, especially in Swansea. One example is from the Swansea Useful Knowledge Society. In 1846, a Mr. Fisher delivered a lecture to a large audience. The attendees were “highly pleased with the lecturer’s description and elucidations of this beautiful and sublime science.”<sup>117</sup> Reports of

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<sup>113</sup> “Neath Philosophical Society,” *Cambrian*, April 23, 1842, <http://newspapers.library.wales/view/3330310/3330313/9>.

<sup>114</sup> “Sidereal Astronomy,” *Carnarvon and Denbigh Herald and North and South Wales Independent*, November 24, 1838, <http://newspapers.library.wales/view/3643469/3643473/21>.

<sup>115</sup> “Sidereal Astronomy.”

<sup>116</sup> “Sidereal Astronomy.”

<sup>117</sup> “Glamorganshire,” *Welshman*, April 24, 1846, <http://newspapers.library.wales/view/4364715/4364718/18>.

crowded audiences were not uncommon, as lecturer's often experienced crammed theatres and halls. By the mid-century lecturers performed to consistently full theatres.

The theme of education was crucial to the success of astronomical lecturing. At the Brecon Literary and Scientific Institute in 1842, a Dr. Lucas' discussions on astronomy stressed that members "read, and apply themselves to the cultivation of the mind." His introductory lessons on astronomy stressed the methods through which one could become an astronomer. The *Monmouthshire Merlin* reported on Lucas' lectures. He was reported as stating, "[w]ere they but to apply themselves one hour in the day to the study of the natural history of the globe, he would venture to say that they would become masters of a general knowledge of it in four years. The respected lecturer then sat down amid loud applause."<sup>118</sup>

Language was crucial when performing to science societies. After a lecture by John Thomas, the *Monmouthshire Merlin* was relieved that he, "avoided as much as possible the trite portion of the subject, and presented the audience with matter entirely new, in a form creative of unusual interest, and very clearly arranged."<sup>119</sup> Thomas' emphasis on the "utility of astronomic knowledge" helped elevate his lectures, and the institution deemed that the practical applications of astronomy were "forcibly shown." Overall, Thomas delivered a "masterly lecture" to the society members.<sup>120</sup> Through a combination of language and spectacle, lecturers created a unique space for entertainment and education. However, English-speaking lecturers encountered challenges with Welsh-speaking audience members when their eloquent descriptions could not

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<sup>118</sup> "Brecon Literary and Scientific Institute," *Monmouthshire Merlin*, January 1, 1842, <http://newspapers.library.wales/view/3393595/3393598/29>.

<sup>119</sup> "Merthyr," *Monmouthshire Merlin*, February 7, 1846, <http://newspapers.library.wales/view/3425250/3425252/19>.

<sup>120</sup> "Merthyr."

be understood. A lecturer needed more than just an orrery, he needed to properly communicate with the audience what they were seeing and how best to comprehend it.

### Welsh-Language Lecturing

Many lecturers travelled throughout Wales performing for different audiences, but Robert Roberts was undoubtedly the most prominent Welsh lecturer and astronomer during the first half of the century. Roberts was renowned as an astronomer, poet, author, and almanac maker, while he also ran a private academy.<sup>121</sup> He has the distinction of being the first reported individual to lecture on astronomy in the Welsh language. The *Carmarthen Journal* announced Roberts' lectures: "[w]e understand that Mr. Robert Roberts, of Holyhead, the author of the *Welsh Gazetteer*, intends shortly to deliver Astronomical Lectures in this Town, in our Mother tongue. From his well-known talents and knowledge of Astronomy, we angur [*sic*] that he will be well and deservedly encouraged."<sup>122</sup> Roberts was already a renowned astronomer, but touring as a lecturer further elevated his social status and scientific authority. Roberts' Welsh-language astronomical lectures were also recounted by the *Cambrian* in 1828:

ASTRONOMICAL LECTURES IN WELSH.-- The celebrated Welsh Geographer and Astronomer, Mr. Roberts, of Holyhead, has lately delivered several lectures on Astronomy in North Wales, in the mother tongue, which were illustrated by a beautiful Orrery, conducted by his son, a promising youth. It is said that Mr. R. intends visiting the principal towns in Wales, and we certainly wish his success in his arduous undertaking.<sup>123</sup>

A poem written alongside the article praising Roberts' work noted that his lecture at Dolgellay, north Wales, in 1828 was the first ever delivered in Welsh. The poem praised Roberts mightily,

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<sup>121</sup> Roberts' publications will be discussed in more detail in chapter 3.

<sup>122</sup> "Carmarthen, December 19," *Carmarthen Journal and South Wales Weekly Advertiser*, December 19, 1828, <http://newspapers.library.wales/view/3794678/3794681/17>.

<sup>123</sup> "Astronomical Lectures in Welsh," *Cambrian*, December 13, 1828, <http://newspapers.library.wales/view/3326860/3326863/11>.



and described the powerful illustrative power of his orrery and his eloquent descriptions and narrative structure. The mention of his son travelling and aiding his lectures demonstrates that lecturing was a multi-generational business in the nineteenth century.<sup>124</sup> After performing at Dolgelley, Roberts was described as “the grandfather of the ether,” demonstrating his authority as Wales’ most esteemed astronomer, as well as a dilettante of astronomical knowledge.<sup>125</sup>

Roberts planned to visit other towns in south Wales, and newspapers expressed the excitement that the public felt towards his potential performances and promotion of Welsh literature. After his lectures in north Wales, one article reported that “the rooms [were] so crowded, the public requested him to continue a few evenings longer than he at first intimated.”<sup>126</sup> The desire for astronomical knowledge is evident through the mass of advertisements of astronomy books, private schools programs, and lectures, however the presence of a Welsh-speaking lecturer was most significant. Finally, Welsh speakers had access to the scientific learning that was so desired.

The *North Wales Chronicle and Advertiser for the Principality* noted that after Roberts’ five nights of lecturing in Bangor, that the interest was intense, “[s]uffice it to say, that the interest excited here, by this never-before witnessed exhibition, affords a pretty sure presage of the astronomer’s future success in his intended tour.”<sup>127</sup> After his tour in south Wales, Roberts

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<sup>124</sup> Adam Walker and his sons are the prime example of a lecturing dynasty. Other families that will be later discussed include the Mills and the Dillwyns.

<sup>125</sup> Original text: “Bur arian yr Wybreni.” This was part of a poem that was “composed on hearing the first Welsh Lecture on Astronomy” by an audience member in Dolgelley in November, 1828, and subsequently reproduced in both the *Cambrian* and the *North Wales Chronicle and Advertiser for the Principality* the following month. “Astronomical Lectures in Welsh;” “Science in the Principality,” *North Wales Chronicle and Advertiser for the Principality*, December 18, 1828, <http://newspapers.library.wales/view/4458980/4458983/15>.

<sup>126</sup> “Science in the Principality.”

<sup>127</sup> “Science in the Principality,” *The North Wales Chronicle and Advertiser for the Principality*, December 25, 1828, <http://newspapers.library.wales/view/4458985/4458988/14>. This article bears the same title as one published the previous week. Roberts’ endeavours were a regularly reported event.

was expected back in Bangor for more lectures. One correspondent wrote a letter to the editor of the *North Wales Chronicle*, and he detailed the demand for scientific education in Wales:

Happily, Science now begins to shed her bright radiance even over the ragged and drearily benighted regions of the Principality. These remarks are suggested by the unexpected but welcome visit of the celebrated Welsh astronomer, Mr. Roberts of Holyhead, to this place; whose Orrery and Lectures have excited the most intense curiosity, and highly interested the inhabitants of the town and vicinity. The lectures are delivered very fluently in the Welsh language, with occasional explanations of the technical terms; and the accompanying astronomical phenomena are exhibited by the orrery, so as to render the whole intelligible to the simplest capacity. The able lecturer is on a tour through Wales to try the Cambrian taste for this entertaining and instructive department of science. Mr. Roberts has exhibited his orrery at the National School Room, in this town, for five nights, and delivered lectures on astronomy, in his native tongue, to crowded respectable audiences, with the most marked approbation and unbounded applause. Suffice it to say, that the interest excited here, by this never-before witnessed exhibition, affords a pretty sure presage of the astronomer's future success in his intended tour.<sup>128</sup>

Accompanying the letter is the correspondent's poem in Welsh honouring Roberts and praising him for his lectures and astronomical knowledge. The relationship between astronomy and poetry was often emphasized in the endeavours of Welsh-speaking lecturers.

For many of the public in south Wales, Roberts' lectures were their introduction to astronomy. Roberts' lecture tour brought about the revival of previously disbanded scientific societies. Upon Roberts visiting Carmarthen in 1834, the Carmarthen Cymreigyddion Society was re-established with "redoubled spirit."<sup>129</sup> The Cymreigyddion Society awarded Roberts a silver medal after a course of lectures, and invited him back to discuss astronomy further. Roberts was noted as being the first to lecture in "our mother tongue on this interesting subject," and "the easy flow of his language, and the classical purity of his style, cannot fail to excite the admiration of all who may have an opportunity to attend his lectures."<sup>130</sup> Roberts embodied the

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<sup>128</sup> "Science in the Principality."

<sup>129</sup> "Carmarthen Cymreigyddion Society," *Glamorgan Monmouth and Brecon Gazette and Merthyr Guardian*, April 5, 1834, <http://newspapers.library.wales/view/3631350/3631353/24>.

<sup>130</sup> "Carmarthen Cymreigyddion Society."

ideal astronomical lecturer in the Welsh context: a powerful combination of sublime illustrations, the use of fantastical language, and the invocation of natural theological motivations for observing the heavens. He held a virtual monopoly on Welsh-language lecturing until his death in 1836. Roberts was compared to the “Druids of Great Britain” in articles, where astronomy was a deep-rooted culturally prominent activity in Wales.<sup>131</sup>

Welsh astronomers like Roberts became revered throughout Wales and druidic comparisons further cemented astronomers’ cultural authority. The druids predated Christianity in Britain and their work survived through the form of poetry and song. Famous Welsh chronicles like the *Triads* and the *Mabinogion* were littered with astronomical references that were emphasized throughout the century in comparisons to contemporary astronomers.<sup>132</sup> Roberts’ status as a poet also benefitted his social status. Eighteenth-century poets perceived bards as direct descendants from the druids. This belief was spread by the famous poet Iolo Morganwg, who had a reputation as a brilliant poet and scholar.<sup>133</sup>

While Roberts was the first Welsh lecturer, his legacy was carried on by Edward Mills. Local scientific societies invited Mills to deliver lectures as early as the 1830s. One example is the Merthyr Literary and Scientific Institution:

On Tuesday evening a lecture on Astronomy was delivered at this Institution, by Mr. Mills, who illustrated his discourse by an Orrery, and other apparatus. The lecturer treated his subject in a lucid and comprehensive manner, in which he gave a clear and intelligible explanation of the movements of the heavenly bodies, and afforded high gratification to his auditory. He afterwards gave a synopsis of his

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<sup>131</sup> “Carmarthen Markets,” *Carmarthen Journal and South Wales Weekly Advertiser*, January 30, 1829, <http://newspapers.library.wales/view/3794708/3794711/15>.

<sup>132</sup> For example, Iolo Morganwg’s compilation of the *Triads* included an excerpt on the “threerenowned astronomers of the Isle of Britain.” Iolo Morganwg, *The Triads of Britain*, trans. W. Probert (London: Wildwood House, 1977), 59. The *Mabinogion* is the title of a collection of medieval Welsh prose taken in the White Book of Rhydderch and the Red Book of Hergest. The poems were not a collection until the nineteenth century after being translated into English by Lady Charlotte Guest. They reflect themes from Celtic mythology and folklore. Sioned Davies, trans. *The Mabinogion* (Oxford: Oxford University Press, 2007), 179-213. Astronomy’s significance in different publications will be discussed more in chapter three.

<sup>133</sup> Iorwerth C. Peate, *Tradition and Folk Life: A Welsh View* (London: Faber and Faber Ltd., 1972), 66.

discourse in the Welsh language, which excited the greatest interest among his hearers of the *Cymraeg* dialect. A vote of thanks to him was afterwards moved, and carried by acclamation. The Lecture Room was very respectably filled, and the whole proceedings reflect great credit on the infant Institution.<sup>134</sup>

J. Silas Evans noted the prominence of Mills in Welsh social circles. His portable orrery was reportedly 66-feet in circumference, and was hailed by Evans as one of the “wonders of the age.” Poets sang his praises, while he was known as “the astronomer” of the prominent Mills family.<sup>135</sup> Specifically Welsh-language astronomical figures gained cultural prominence for their work. Individuals like Roberts and Mills continued a perceived astronomical tradition that became associated with Welsh cultural icons, like the druids and bards.<sup>136</sup>

## Education

The quality of early-century education in Wales is hard to evaluate, but the 1847 *Report into the State of Education in Wales* provides data that reveals how the Welsh valued Sunday school teaching.<sup>137</sup> The 505-page report detailed 1687 day schools and 2713 Sunday schools. Day school curriculums allowed for religious instruction, reading, writing, arithmetic, navigation, and astronomy; all but three day schools were taught through the medium of English. For Sunday schools, the only information provided was the language of instruction and the number of pupils “able to read the scriptures.”<sup>138</sup> The disparity between the details both types of schools demonstrates that the Commission considered day schools as a more legitimate form of

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<sup>134</sup> “Literary and Scientific Institution,” *Glamorgan Monmouth and Brecon Gazette and Merthyr Guardian*, December 16, 1837, <http://newspapers.library.wales/view/3632225/3632228/19>.

<sup>135</sup> Original text: “ryfeddodau yr oes.” Evans, *Seryddiaeth a Seryddwr*, 271.

<sup>136</sup> Mills and Roberts will be discussed more in chapter three.

<sup>137</sup> This event became known as “Brad y Llyfrau Leision” (The Treachery of the Blue Books). The validity of this commission can also be confirmed by comparing their numbers to that of the 1851 census on education. Dot Jones, *Statistical Evidence Relating to the Welsh Language 1801-1911* (Cardiff: University of Wales Press, 1998), 338, 342. For more on the Blue Books, see Jones, *A History of Education in Wales*, 56-74; Roberts, *The Language of the Blue Books*, 207-232.

<sup>138</sup> Jones, *Statistical Evidence Relating to the Welsh Language*, 339.

education. However, the value of Sunday schools must be considered when discussing education in Wales; they were often the only education many in Wales received, and often served as a first introduction to astronomy for many Welsh people.

Over a quarter of a million students were recorded as attending Sunday school, almost half of Wales' total population, and nonconformist denominations dominated, including Calvinistic Methodists, Independents, Baptists, and Wesleyan Methodists. Girls and boys attended in almost equal numbers, while there were nearly as many men and women attendees as children. Additionally, only 15 percent of pupils, primarily in the counties of Pembroke, Radnor, and Monmouth, were taught in the English language.<sup>139</sup> Sunday schools became a uniquely Welsh-language form of education where astronomical knowledge was disseminated.

Many adult members had attended since childhood and Sunday schools were their primary form of literacy training. Commissioner Jellynger C. Symons even stated that “the Welsh peasantry are better able to read and write in their own language than the same classes in England.”<sup>140</sup> Welsh people also supported Sunday schools far greater than other educational institutions. Sir Henry Jones remarked that the Sunday school was “the sanest of all education institutions... for it rests on the assumption that the care of the soul, like the care of the body, should be life-long.”<sup>141</sup> Attendees often went to Sunday schools for their entire lives. Jones detailed the significance of the Sunday school institution and noted on his Grandfather's enthusiasm for education: “[h]e was over seventy years of age at the time, and so, I have no doubt, were most if not all of his fellow-scholars in the class.”<sup>142</sup> The success of Sunday schools

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<sup>139</sup> Jones, 341.

<sup>140</sup> Jones, 343.

<sup>141</sup> Sir Henry Jones wrote an autobiography on his struggle to attain education growing up in rural north Wales. He went on to become the Professor of Moral Philosophy at the University of Glasgow. For more, see Sir Henry Jones, *Old Memories: Autobiography of Sir Henry Jones* (London: Hodder and Stoughton, 1924), vii, 15.

<sup>142</sup> Jones, *Old Memories*, 14.

in teaching reading skills created a demand for more Welsh-language material that supported a sustained increase in publications and lectures from the mid-nineteenth century onwards.

In addition to Sunday schools, many private academies opened during the first decades of the century. In 1804, G. Hazel advertised his boarding school in Swansea for young gentlemen, which noted the teaching of subjects such as algebra, geography, and astronomy. Admission to the school was twenty-two guineas per annum, with an additional three guineas for lessons on navigation, lunar observations, and double altitudes.<sup>143</sup> Astronomy was a consistent subject in the schedules of private academies. Hazel's school was advertised again in 1805 and in subsequent years.<sup>144</sup> Moreover, Reverend R. Evans' "School for Young Gentlemen" opened in 1809 at White-Walls, Swansea. Evans offered courses on Greek and Latin, English, mathematics, geography, the use of globes, and astronomy.<sup>145</sup> Academy lessons mirrored the content of public lectures.<sup>146</sup> Evans' and Hazel's schools serve as examples of early institutions which taught astronomy. Astronomy was an important subject in early academies for its practical uses, while it piqued the interest of pupils.

One advertisement for a Cardiff school at the end of 1814 promoted the hiring of a new teacher, Joseph Williams, who was to begin teaching the following year. Williams was touted for his "knowledge in Algebra, Geometry, Astronomy, &c." The boarding school's advertisement was printed in both English and Welsh, and also noted that Williams would answer astronomical

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<sup>143</sup> Double altitudes were used in celestial navigation. By observing the altitude of the sun before it reaches the meridian and then again at the same altitude after it passes the meridian. Navigations determined the local noon by taking the midway point between the times of the observations. "Advertising," *Cambrian*, July 7, 1804, <http://newspapers.library.wales/view/3320755/3320757/3>.

<sup>144</sup> "Advertising," *Cambrian*, July 6, 1805, <http://newspapers.library.wales/view/3321010/3321013/3>.

<sup>145</sup> "Advertising: Education," *Cambrian*, March 25, 1809, <http://newspapers.library.wales/view/3321930/3321931/1>.

<sup>146</sup> Hazel's and Evans' schools taught the same content as lectures attended by Evan Davies and John Price. Other topics included the parallax of planets, calculating astronomical units, and calculating the distance between stars. Papers of Evan Davies, *Cardiff MSS*, reel 2.949; Scientific Notes, *Cardiff MSS*, reel 1.442.

questions by both men and women.<sup>147</sup> Knowledge of astronomy was a major ‘pull factor’ in bringing both male and female students into academies.

Moreover, astronomy remained an important subject for its dual-purpose applications of practical knowledge and religious confirmation. Early nineteenth century academies often advertised the teaching of astronomy before any other branches of science, and advertisements reveal the preferences for practical scientific teaching. The Eastwood House Academy in Pembrokeshire was opened for “youth prepared for the Military, Marine, Civil, and Commercial Departments.”<sup>148</sup> The aim of the academy was to admit a limited number of “Young Gentlemen” of any age to teach topics of “the utmost attention” including Latin and Greek Classics, English, Arithmetic, Geography and the use of globes, navigation, and branches of astronomy. The advertisement specifically noted that lectures were to be delivered on astronomy using illustrative tools including globes, orreries, tellurians, planetariums, astronomical phantasmagoria, quadrants, telescopes, barometers, air pumps, lunar and solar spheres, and optical machines.<sup>149</sup> These early advertisements demonstrate the significance of visual tools in the teaching of astronomy, as well as astronomy’s prominence in education curriculums, emphasized as part of a complete education.

Astronomy formed an important part of many lessons in schools. The training of teachers themselves also reveals that astronomy and science were valued as teachable subjects. By 1850, the National Society for the Education of the Poor was formed, and one of the society’s aims was to better educate teachers. Schoolmasters from Bangor and St. Asaph, north Wales, met at the Caernarfon Training Institution for formal training in teaching. A total of 57 teachers, 26 from

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<sup>147</sup> “Advertising,” *Seren Gomer*, December 24, 1814, <http://newspapers.library.wales/view/4247460/4247463/11>.

<sup>148</sup> “Advertising,” *Cambrian*, October 31, 1812, <http://newspapers.library.wales/view/3322855/3322856/1>.

<sup>149</sup> “Advertising.”

St. Asaph, 15 from Bangor, and 16 students in training gathered for the conference which ran for one month. One report on the meetings noted, “[a] considerable majority of the masters had never previously received instruction at a training institution; to them, therefore, the present opportunity was of the greatest value.”<sup>150</sup> The main goal of the institution was to educate instructors on how to better teach students the most important subjects. Each day followed the same routine, with lessons on Holy Scripture, geography, English grammar, singing, mechanics, algebra, arithmetic, and astronomy. A portion of the afternoon was especially devoted to, “Astronomy, Use of Globes, and Elementary Lectures on Natural Philosophy.”<sup>151</sup> With much of the Welsh population attending Sunday school at some point in either childhood or adulthood, astronomical teaching reached most people in Wales on a multi-generational level.

Scientific education was consistently touted as an element of social development within local newspapers and later with popular publications. In the *Cambrian*, the high standing of British society was credited to the position of science within education:

It cannot be doubted that we have risen to the station which we occupy, not by literature, not by the knowledge of extinct languages, but by the sciences of politics, of law, of public economy, of commerce, of mathematics, by astronomy, by chemistry, by mechanics, by natural history. It is by these (adds he) we are destined to rise yet higher. These constitute the business of society, and in these ought we to seek for the objects of education... and more conducive to the wealth, the tranquility, and happiness of the whole community.<sup>152</sup>

Science was perceived as the key to succeeding in life, and astronomy constituted a significant part of scientific education. Private academies, day schools, and Sunday schools taught the importance and practical applications of scientific education in the early century. Introductory

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<sup>150</sup> “National Society for the Education of the Poor,” *North Wales Chronicle and Advertiser for the Principality*, November 9, 1850, <http://newspapers.library.wales/view/4521057/4521060/11>.

<sup>151</sup> “National Society for the Education of the Poor.”

<sup>152</sup> “Introductory Discourse,” *Cambrian*, December 30, 1826, <http://newspapers.library.wales/view/3326350/3326354/17>.



lessons on astronomy created a demand in communities for more astronomical learning. This demand was answered by lecturers, where audiences found a space where education and entertainment were combined to create a unique experience throughout the century.

### **Other Cultural Connections**

The connection made between astronomy and art was illustrated through poems on astronomy. In addition to many astronomers also writing poetry and music, astronomical poems appeared in literature and newspapers for the public, in addition to poetry being present in astronomical lectures.<sup>153</sup> Newspapers perceived poets as astronomers and vice versa. The immortalized Welsh poet, Taliesin, had a wife named Ceridwen who was noted for studying astronomy, “with due attention to the books of astronomy, and to the hours of the planets.”<sup>154</sup> Wales’ cultural heroes were portrayed as scientific individuals, poets, and musical geniuses; art and science were connected through these shared cultural histories.

Astronomy was connected to Welsh cultural myths and legends to appeal to audiences across Wales and incorporated astronomy into a new Welsh cultural milieu. Much like the druids, Taliesin and his order of bards, *Y Gwir Yn Erbyn Y Byd*, were suppliers of astronomical knowledge.<sup>155</sup> One author noted that Taliesin and the bards’ knowledge was “equally correct and profound, which answered the same purpose as our more correct and profound astronomy

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<sup>153</sup> See, for example, “A Question,” *North Wales Gazette*, March 22, 1810, <http://newspapers.library.wales/view/3871780/3871784/22>. Evan Davies’ notes taken during a lecture in the midcentury included Welsh poetry excerpts alongside his astronomical calculations. Papers of Evan Davies, *Cardiff MSS*, reel 2.949.

<sup>154</sup> “Welsh Literature by Morgan Llewelyn,” *Monmouthshire Merlin*, February 10, 1849, <http://newspapers.library.wales/view/3394591/3394595/56>.

<sup>155</sup> Taliesin was perhaps the most famous medieval Welsh bard and his order of bards were employed by every Welsh prince. He was used as a symbol of a new Welsh identity in the nineteenth century that embodied poetic art and served as a mythic crucible. Emyr Humphreys, *The Taliesin Tradition: A Quest for the Welsh Identity* (London: Black Raven Press, 1983), 1-4.

answers now, that of elevating the mind, as the eidouranion lecturers have it, to sublime contemplations.”<sup>156</sup> Astronomical lecturers were perceived as carrying on a cultural tradition that began with the druids. Astronomy’s cultural connections enabled its popularity to grow significantly; it was the continuation of bardic and druidic tradition that had maintained practical and spiritual benefits to its learners. As one author stated, “the testimony of classical or foreign authors as to the proficiency of the Druids in the knowledge of astronomy is positive and strong.”<sup>157</sup> The main focus of these astronomer-druids was to educate children.

Within communities, individuals with knowledge of astronomy were revered. One example is Gwilym Morganwg from Brecknock, Powys, who was a celebrated poet since the age of twelve. Through working with the parish clerk and stone cutter Rhys Howel Rhys, Morganwg “acquired an excellent knowledge of Astronomy.” Morganwg was labeled as the “Welsh Burns.” Upon his death in 1835 he was celebrated for his poetry and knowledge in the sciences.<sup>158</sup>

Astronomy took a prominent position in the stronghold of Welsh cultural expression, the eisteddfodau.<sup>159</sup> During the century, eisteddfodau prose sections often included a “scientific” competition. Competitors were required to write original essays on scientific subjects, while prizes were offered for the best translation of an English-language scientific piece. One example is at the Ivorite Eisteddfod in Pontypridd in 1851. Here, a prize was awarded for “the best short essay on the Laws of Motion.”<sup>160</sup> The eisteddfodau reflected the importance of adhering to the Welsh language when presenting scientific material. Like Sunday schools, eisteddfodau were an

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<sup>156</sup> “The Education of Taliesin,” *Carmarthen Journal and South Wales Weekly Advertiser*, April 24, 1829, <http://newspapers.library.wales/view/3794768/3794772/23>.

<sup>157</sup> Alban Elved, “The Traditionary Annals of the Cymry,” *Cambrian Journal*, (1861): 236. <https://journals.library.wales/view/2072171/2074987/74>.

<sup>158</sup> “Gwilym Morganwg,” *Glamorgan Monmouth and Brecon Gazette and Merthyr Guardian*, August 22, 1835, <http://newspapers.library.wales/view/3631690/3631693/31>.

<sup>159</sup> The eisteddfod is a Welsh language yearly poetry event hosted in different towns around Wales.

<sup>160</sup> Hughes, “The Welsh Language in Technology and Science,” 420.

excellent medium through which to disseminate astronomical knowledge because of the prominence of the Welsh language in their composition. Poetry and astronomy had a unique relationship that demonstrated the cultural experience of astronomical practice. The two were “kindred thrones” which possessed the power to “lift the mind above the stir of earth, and win it from lowthoughted [*sic*] care.”<sup>161</sup> Poetry was used as a tool to express astronomical findings and enable new conceptions of the vastness of the universe and contemplations of existence.

## Conclusions

Ultimately, lecturing helped to secure the future success of astronomy in Wales. First beginning with Sunday school teachings, a demand for astronomical knowledge only increased over the course of the century. Travelling lecturers experienced a boost in popularity in Wales, as Lloyd, Goodacre, Rogers, Keevil, Franklin, and others found favourable markets for astronomical lecturing in both north and south Wales. Chapels, town halls, school rooms, and theatres were temporarily transformed into sites for the consumption of astronomical knowledge, where Welsh cultural themes were prevalent. Lecturers combined visual spectacle with sublime language and narrative to both entertain and educate audiences from many different social backgrounds. Roberts and Mills appealed to Welsh-language audiences in a market where there were few Welsh lecturers. Numerous lecture tours were successful throughout the century because of the considerable lecturing market in Wales. Sunday schools created an environment that was conducive to scientific learning and attracted men, women, and children. The cultural elevation of the astronomer through comparisons to poetry and religious devotions enabled the development of astronomy during the century.

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<sup>161</sup> Daw, “The Victorian Poetic Imagination and Astronomy,” 16.

## Chapter 2

### **“what can be more weird, more wonderful, more stupendous than the teachings of Astronomy?”: Astronomers, Observatories, and Telescopes**

And now at last we, of the Principality, have an Astronomical Society of our own.<sup>162</sup>

Arthur Mee’s Presidential address at the formation of the Astronomical Society of Wales in 1894 demonstrated the longing that many observers had felt for their own provincial astronomical society. Astronomy held cultural authority in Wales, as discussed in the previous chapter, and this cultural influence was further enshrined through the perceived power and authority of astronomers and their observatories and telescopes. When a telescope was housed in an observatory, it became a culturally significant site where not only was astronomical work carried out, but public perceptions of astronomical spaces demonstrated the cultural power of the observatory and the astronomer. Local publics viewed astronomers as social leaders and ascribed them with culturally meaningful titles and roles. Moreover, a modern scientific community emerged during the century that promoted the production of astronomical knowledge. High quality telescopes became affordable during the second half of the century as new scientific societies enabled beginners to practice astronomy in a welcoming, supportive community. But, as A.J. Meadows asserts, limitations on travel made it difficult for more distant practitioners of science to take part in the first new societies forming in London.<sup>163</sup> In Wales, astronomers operated in a more local, rural context to create a new scientific community that embodied principles of serious leisure, scientific discourse, and above all a love of astronomy.

Practicing astronomy was a social experience. Shared astronomical interests compounded with the first local scientific societies that emerged in the midcentury. They were inherently

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<sup>162</sup> Arthur Mee, “President’s Address,” *Journal of the Astronomical Society of Wales* (1895): 4.

<sup>163</sup> Meadows, *The Victorian Scientist*, 80.

social institutions that created a unique place where individuals gathered to discuss interests in science regardless of political affiliations and played a significant role in the movement to establish a revitalized Welsh identity.<sup>164</sup> Astronomy became both a serious and casual leisure activity where its practitioners were not concerned with questions of profit but had goals of self-expression, gratification, recreation, and group accomplishment. Public image was also important, and was important for the maintenance of astronomical authority. Astronomers were both producers and consumers of knowledge who functioned as practitioners of serious leisure. I argue that astronomers operated within their local communities to promote astronomy as a cultural activity that granted social, religious, and personal benefits.

### **The Dillwyn Family: A Scientific Dynasty**

Individuals developed science in Wales by connecting their local communities with broader scientific networks. The Dillwyn family provides an example of this point. They were renowned throughout Wales for much of the century for their various roles in politics and industry, but especially in their relationship to science. The Dillwyns were an astronomical dynasty during the nineteenth century that helped to transform Swansea into a scientific hub. Lewis Weston Dillwyn was born in 1778 and moved to Swansea in the early nineteenth century. He was “actively instrumental” in the establishment of the *Cambrian* in 1805.<sup>165</sup> The newspaper published significant amounts of material on science, including news on lectures, books, schools, and society meetings; it was one of the key printed sources that brought astronomical knowledge

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<sup>164</sup> Science often transcended political boundaries as society members joined together for the betterment of science. For example, the membership list of the Merthyr Literary and Scientific Institution in 1837 consisted of local reform-minded moderates and radicals alike who put aside their differences and “rallied around the banner of science” during the Merthyr rising in 1831. Morus, *William Robert Grove*, 15; Lichtenwalner, *Claiming Cambria*, 118-123.

<sup>165</sup> Thomas Williams Soranus, *The Science and Scientific Men of Wales. Lewis Weston Dillwyn, Esq., of Swansea* (Tenby: R. Mason, 1855), 19.

and news to the public and enabled the growth and popularity of astronomy. Lewis Weston Dillwyn was featured in *The Science and Scientific Men of Wales* series which highlighted Wales' most prominent scientific individuals. The series' author, Thomas Williams Soranus, argued that practitioners of science deserved as much recognition as poets:

The painters, sculptors, chemists, geologists, engineers, botanists, naturalists, and the physicians and physiologists of a country, no less, indeed, than its poets, musicians, and historians, deserve to be canonized as its "great men," and venerated as its demi-gods. If the present effort should but kindle in others - more able than he who now presumptuously desire for further conquest, good service will have been rendered to the cause; and the science, and men of science in Wales will cheer, gratefully responsive to the labour.<sup>166</sup>

Soranus noted a rise in scientific activity in Wales that coincided with the growth of science across Britain in the midcentury. Swansea was emphasized as the new Welsh metropolis, where its scientific activity brought prestige to Wales. Weston Dillwyn's local efforts in the town were "an imposing *sum* of intellectual and mercantile activity, which, in accents at once visible and audible, proclaim it as 'the land of promise'."<sup>167</sup> Swansea's emerging scientific centre was dependent on the work of Weston Dillwyn. He served as an MP for Swansea from 1834 to 1841, and worked as the owner and manager of Swansea Cambrian Pottery; his local influence and power was crucial to the success of the Royal Institution of South Wales which drew the BAAS to Swansea in 1848.<sup>168</sup> Lewis Weston Dillwyn's role in the rise of the metropolis of Swansea facilitated new scientific endeavours, while his children created scientific careers of their own.

Lewis' son, John Dillwyn Llewelyn, became a prominent astronomer by midcentury, and he was perceived as one of Wales' premier men of science by his peers in Britain and Ireland. He first gained recognition when he became the vice president of the Swansea Literary and

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<sup>166</sup> Soranus, *The Science and Scientific Men of Wales*, 3.

<sup>167</sup> Soranus, 6.

<sup>168</sup> Birks, "The Penllergare Observatory," 3.

Scientific Institution upon its establishment in 1835.<sup>169</sup> In 1851, he built the most prominent observatory in Wales during the nineteenth century at the Penllergare estate. The observatory was often opened to visitors, and in 1848 during the BAAS' visit to the town Dillwyn Llewelyn operated tours of the observatory.<sup>170</sup> Dillwyn Llewelyn is possibly one of the only astronomers in Wales who fits into Chapman's definition of the "Grand Amateur," which further highlights the need for new definitions of astronomers according to their local and cultural context.

Dillwyn Llewelyn inherited the Penllergare estate in 1817 from his grandfather, Colonel John Llewelyn. He took on the additional surname of Llewelyn after becoming a local squire, and later served as both a magistrate and High Sheriff of Glamorgan.<sup>171</sup> Dillwyn Llewelyn's observatory at Penllergare was constructed with an adjoining laboratory for photographic work. He was elected a Fellow of the Royal Astronomical Society in 1852 after being nominated by prominent astronomers President Admiral W.H. Smyth, John Couch Adams, and Richard Sheepshanks.<sup>172</sup> His election reflected his astronomical strong connections across Britain.

Together with his daughter Thereza, Dillwyn Llewelyn engaged with new photographic work and in 1854 took one of the earliest photographs of the moon. Penllergare Observatory was the most prominent observatory in Wales during the nineteenth century. However, there were a few that preceded it, such as Lewis Evans' observatory in Woolwich Common, and Charles Francis Greville's observatory at Hakin, near Milford Haven.<sup>173</sup> Other observatories existed in

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<sup>169</sup> Morus, *William Robert Grove*, 18.

<sup>170</sup> Morus, 100.

<sup>171</sup> Birks, "The Penllergare Observatory," 3-4.

<sup>172</sup> Birks, 4. Adams was credited as one of the co-discoverers of the planet Neptune in 1845 with French astronomer Urbain Le Verrier. For more on Le Verrier, Adams, and Neptune, see James Lequeux, *Le Verrier: Magnificent and Detestable Astronomer* (New York: Springer, 2013), 21-53.

<sup>173</sup> The only mention of Evans' observatory is by J. Silas Evans where he plainly stated that "[h]e built an observatory in Woolwich Common" ("Adeiladodd Arsyllfa ar Woolwich Common"). Evans, *Seryddiaeth a Seryddwr*, 267. Greville's observatory was part of a larger plan for the construction of a mathematics, navigation, and technical college. The project was funded by Colonel Alexander Read. A large collection of instruments was gathered and Thomas Firminger, former assistant to Nevil Maskelyne at Greenwich, was appointed as the

Wales, such as at Machynlleth, but their operations have only been rarely noted in newspapers.<sup>174</sup>

Penllergare was originally made with wood and copper cladding. It was drum-shaped and nineteen feet in diameter, while the adjoining laboratory was ten feet wide and twenty feet long and made with bricks to provide temperature stabilization for photographic work. There is evidence of Dillwyn Llewelyn purchasing a 4 ¾-inch Dolland refracting telescope in 1846, but Birks argues that the size of the observatory suggests that it housed a refracting telescope with an aperture between 6 and 8 inches.<sup>175</sup> Thereza's diary also referenced a "speculum telescope," but it has not survived.<sup>176</sup> Some of Britain's most illustrious men of science visited the estate, such as William Hyde Wollaston and Humphry Davy, both of whom were "intimate acquaintances" with the Dillwyn family.<sup>177</sup> Dillwyn Llewelyn was also a "great friend" of the Earl of Rosse.<sup>178</sup> Penllergare served as an astronomical centre that drew prominent scientific men to Wales and helped to link Swansea to astronomers across Britain and Ireland.

Penllergare is perhaps in fact the only observatory in Wales in the modern sense of the word, but astronomers had a different concept of what constituted an "observatory."

Astronomers set up "telescope rooms" in their homes and called them their own observatories. A telescope room transformed an ordinary room in a house into a space of scientific knowledge production. Observatories often had adjoining houses for much of the century. One example is

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superintendent for the construction of the observatory. However, Greville died in 1809 and the project was abandoned. Greville's instruments were sold to Reverend Lewis Evans in Kent. Bryn Jones has also compiled a list of different observatories in Wales during the nineteenth and twentieth centuries. Bryn Jones, "Astronomical Observatories," accessed February 14, 2018, <http://www.jonesbryn.plus.com/wastronhist/observatories.html>.

<sup>174</sup> Robert Roberts was reported visiting "the observatory in the Unicorn Rooms, in the town of Machynlleth" during his lecture tours, but no other evidence of any work done has survived. "Science in the Principality."

<sup>175</sup> Birks, "The Penllergare Observatory," 5.

<sup>176</sup> Brück, *Women in Early British and Irish Astronomy*, 118.

<sup>177</sup> Soranus, *The Science and Scientific Men of Wales*, 10.

<sup>178</sup> Evans, *Seryddiaeth a Seryddwr*, 271.



William Huggins' observatory at Tulse Hill, London, in the 1850s.<sup>179</sup> Telescopes possessed a unique quality that connected users with the heavens. As Daw states, “the ability of the telescope lens to cause shifting perspectives between the immediate and distant worlds created differing conceptions of space and being, and affected the imagination.”<sup>180</sup> Telescopes, much like orreries, were unique in that they transformed spaces into new sites for astronomical knowledge creation and consumption. Penllergare was similar to Tulse Hill in that two women, Thereza Dillwyn Llewelyn and Margaret Huggins, engaged in astronomical work by transforming the domestic sphere into a scientific space.<sup>181</sup>

Along with his daughter, Dillwyn Llewelyn developed the oxymel photographic process. This process stabilized the photographic image on dry plates instead of wet ones, which were used in the collodion photographic process.<sup>182</sup> The dry plates were much easier to use in a camera that was attached to a telescope. These plates were also considered more light sensitive, and made “instantaneous” photography in daylight possible.<sup>183</sup> Despite Dillwyn Llewelyn's use of the attached photographic laboratory to Penllergare, the observatory was actually made for his daughter Thereza as a present for her sixteenth birthday. Unfortunately, however, most of

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<sup>179</sup> When Huggins first moved to Tulse Hill, he observed the skies with his telescope from his garden. However, Huggins was not satisfied, and constructed a 12x18-foot observatory building to store his telescope, transit circle, and clock. A passageway was made to join the observatory to the second storey of his home, making it “for all purposes of convenience and access, a part of the house.” Becker, *Unravelling Starlight*, 34.

<sup>180</sup> Daw, “The Victorian Poetic Imagination and Astronomy,” 12.

<sup>181</sup> The domestic sphere was a common form of access for women to become involved in astronomy. Early women astronomers, such as Caroline Herschel, worked as “assistants” to their male counterparts at observatories attached to the home in order to gain scientific legitimacy. In 1828, James South, the Vice-President of London's Astronomical Society, awarded Caroline Herschel with a gold medal for her discovery of eight comets and several nebulae, as well as for her calculations of William Herschel's observations. Eight years later, the Royal Astronomical Society made what was perhaps the first statement of equal opportunities in science when they stated, “the sex [of Caroline Herschel] should no longer be an obstacle to her receiving any acknowledgement which might be held due to [men].” Fara, *Pandora's Breeches*, 145-146.

<sup>182</sup> Wet plates caused issues for astrophotographers because they had to be used immediately. Dillwyn Llewelyn's new process made capturing astronomical photos significantly easier. Birks, “The Penllergare Observatory,” 5.

<sup>183</sup> The process also involved more harmful chemicals, however, including mercury, bromine, iodine, and chlorine. This may explain Dillwyn Llewelyn's severe asthmatic conditions he contracted later in life. Birks, 5.

Thereza's work is unknown or unpublished. Besides the early photograph of the moon taken with her father, she also noted the existence of Donati's comet in August 1858 (before it was announced by the Italian astronomer) while on a honeymoon in Europe after marrying the chemist and mineralogist Professor Nevil Story Maskelyne, the grandson of the Astronomer Royal Nevil Maskelyne. Their romance was initiated by a common love of photography and astronomy. They followed in the same line as other prominent scientific couples in the nineteenth century.<sup>184</sup> Thereza undertook new astronomical research at Penllergare, and her and her father's work helped to cement Swansea as Wales' scientific metropolis.

Notes from Thereza's diary, written many years later, reveal how she worked at the observatory in the 1850s with her father. These diary entries also reveal some of her connections with astronomers outside Wales that parallel the correspondence of Margaret Huggins. Thereza noted that, "[i]n 1857 N [her husband] sent me the photo of the Moon taken with Mr de la Rue's telescope - Dec 27th. About this time, if not earlier, my father and I made like photos at Penllergare - without clockwork motion."<sup>185</sup> Thereza was aware of the astrophotography work of other astronomers, and made comments on how she worked the telescope. She continued to describe how they managed to capture their photograph, "[a]bout 1855 my father made a photo of the Moon, and as moonlight requires much longer exposure it was my business to keep the telescope moving steadily as there was no clockwork action. That photograph was one of the first ever made of the Moon."<sup>186</sup> She also corresponded with other astronomers in England with regards to their work. Thereza remarked on the work of other astronomers, "[i]n 1869 a

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<sup>184</sup> Some other couples include William and Margaret Huggins, and William and Caroline Herschel. Much like Caroline Herschel, Margaret Huggins was much more than an assistant. Her work "not only strengthened but also shaped the research agenda of the Tulse Hill observatory." Women were not passive actors in the observatory setting and Margaret Huggins' correspondence with astronomers around the world demonstrated her role in the international astronomical community. Becker, *Unravelling Starlight*, 170.

<sup>185</sup> Birks, "The Penllergare Observatory," 6.

<sup>186</sup> Birks, 6.

photograph now historical and described as being taken ‘at a time when the art of photography was in its infancy’ was made by Sir David Gill, and is now at the Royal Astronomical Society in London.”<sup>187</sup> Apart from their photo of the moon, there seem to be no other surviving original records of either Dillwyn Llewelyn’s or his daughter’s work in astrophotography.

Other members of the Dillwyn-Llewelyn family also helped establish a scientific community in Swansea. Lewis Weston Dillwyn’s other son, Lewis Llewelyn Dillwyn, shared the scientific interests of his brother and father. He married the daughter of the distinguished geologist Sir Henry De la Beche, and also maintained the family’s political status by representing Swansea in parliament from 1855 until his death in 1892.<sup>188</sup> John Dillwyn-Llewelyn’s son, Sir John T.D. Llewelyn, was elected to the BAAS in 1880 and became president of the Swansea Scientific Society in 1885.<sup>189</sup> He played a significant role in encouraging the Society to purchase a telescope for the Royal Institution of South Wales.<sup>190</sup> The Institution later became the Swansea Museum, where all members of the public could use the telescope. Sir John T.D. Llewelyn was also reported for giving tours of Penllergare. He hosted a visit of the Committee of the Swansea Scientific Society in 1888 to the observatory to see the telescope. Specific notes were made on observations of the Moon, Mars, and Jupiter and its moons.<sup>191</sup>

Sir John T.D. Llewelyn was even featured in published poetry for his popularity across Wales. One poem, published in the *Weekly Mail*, hailed him as “one of Cambria’s men of might,” and the author touted the Dillwyns as “the noble family” of Wales.<sup>192</sup> By the twentieth

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<sup>187</sup> Birks, 6.

<sup>188</sup> Griffiths, *The City of Swansea*, 52.

<sup>189</sup> “List of Members,” in *Report of the Fifty-Eight Meeting of the British Association for the Advancement of Science Held at Bath in September 1888* (London: John Murray, 1889), 63.

<sup>190</sup> Birks, “The Penllergare Observatory,” 6.

<sup>191</sup> “An Evening at the Penllergare Astronomical Observatory,” *Cambrian*, June 15, 1888. Cited in Birks, 6.

<sup>192</sup> “To Sir John T.D. Llewelyn, Bart., Penllergaer,” *Weekly Mail*, January 18, 1890, <http://newspapers.library.wales/view/3365489/3365498/64>.

century, the Penllergare estate drew the attention of Swansea when Llewelyn welcomed “thousands of people.” Newspaper reports of the event even featured photographs of the celebrated Llewelyn talking with visitors and demonstrated the social prominence of the Dillwyn family.<sup>193</sup> Three generations of the Dillwyn family facilitated scientific development in Wales and demonstrated the connection between social authority and science. Serious leisure in astronomy was a multi-generational experience.

The work of the Dillwyns was often noted in newspaper reports alongside scientific notices and news. These reports informed readers on the work of scientific practitioners across Britain and contextualized the work of local astronomers with nationally recognized practitioners of science. Prominent astronomers were public figures whose work was promoted in newspapers and other publications that growing audiences over the course of the century. Numerous astronomical publications coincided with the development of astronomical networks, where astronomers worked to connect Wales to these new, larger networks.

### **Other Welsh Astronomers**

Astronomy was an incredibly popular pursuit in Wales because of the connection between astronomy and the Welsh romantic spirit. Astronomers perceived their own role as cultural leaders and that astronomical principles aligned with Welsh cultural norms. Welsh astronomer Arthur Mee echoed these sentiments when he contended that Welsh residents had scientific potential. He claimed, “We are often told that Wales is lacking in the scientific instinct... for the genius of the Celt leans ever to the side of the poetic, the romantic, the mysterious. He is par excellence the child of fancy.” But a romantic, poetic emphasis lent well to

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<sup>193</sup> “Sir John Llewelyn at Penllergaer,” *Cambria Daily Leader*, April 30, 1915, <http://newspapers.library.wales/view/4099097/4099104/93>.

the learning of astronomy. Mee argued that “this mental attitude” of the Welsh, “should tend to the encouragement of Astronomy in Wales... [Astronomy] had its origin in wonder and worship, and romance still tinges deeply the sublimest of the sciences... what can be more weird, more wonderful, more stupendous than the teachings of Astronomy?”<sup>194</sup> Much like the astronomical lecturers, astronomers themselves associated their scientific identity with that of a Welsh cultural heritage. This identity was often emphasized when arguing on behalf of an astronomer’s social connections with Welsh astronomers and the public.

Welshmen working in Britain’s major scientific centres continued to disseminate astronomical knowledge in Wales and work to connect Welsh astronomers with others in England. John William Thomas, born in 1805 in Llandygai, north Wales, worked as one of George Biddell Airy’s first computers at the Royal Observatory at Greenwich. During his early life Thomas was educated by Robert Roberts in Holyhead. He received his astronomical education from the famous Welsh lecturer before becoming a schoolmaster in Tregarth and Ffestiniog and then moving to Greenwich.<sup>195</sup> Despite working from London, Thomas maintained his Welsh roots. He believed that astronomy enriched daily life and sought to introduce his Welsh-speaking friends to astronomy.<sup>196</sup> Thomas was known within Welsh circles in London by the pseudonym Arfonwyson. With the lack of Welsh-language material in the early century, Welsh speakers had to gain knowledge through social interaction and Welsh networks, where Thomas played a major role in establishing these early linkages. He served as a connector between isolated Welsh individuals and the broader astronomical world.

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<sup>194</sup> Mee, “President’s Address,” 3.

<sup>195</sup> Evans, *Seryddiaeth a Seryddwr*, 272.

<sup>196</sup> Hughes, “The Welsh Language in Technology and Science,” 413.

His role at the Royal Observatory at Greenwich was also important. Thomas was hired as a supernumerary computer and paid directly from the Astronomer Royal's funds. He maintained consistent correspondence for George Airy and was extremely significant in managing Airy's letters; all communication went through Thomas' hands before going to Airy.<sup>197</sup> Despite working for years in London, Thomas upheld his Welsh identity and connections with Welsh-speaking friends. He sought to bring astronomical knowledge to Wales and his efforts were continued later in the century by Isaac Roberts.

Isaac Roberts was perhaps the most prominent Welsh astronomer during the nineteenth century despite never working in Wales or with the Welsh language. Roberts was born in Y Groes, south Wales, in 1829 but moved to Liverpool where he made his fortune as a dock manager.<sup>198</sup> Writing on Roberts in the early twentieth century, Evans referred to him as "one of the greatest astronomers, if not the greatest of all, that Wales has ever produced."<sup>199</sup> He engaged in fundamental research on the use of photography to capture astronomical phenomena.

Like Thomas, Roberts spent much of his life in England. However, after his death he was reclaimed as a Welsh icon for his work in astronomy. Roberts was good friends with Eleazar Roberts, Wales' premier astronomical translator.<sup>200</sup> Eleazar Roberts wrote a history of Isaac Roberts in *Y Geninen*, in addition to a detailed obituary in *Ywelydd Misol* in 1905.<sup>201</sup> Evans further documented Roberts' Welsh character in the early twentieth century. He asserted that Roberts' expressed his Welsh identity through his support of educational institutions in Wales at the end of the century. Evans proclaimed, "[a]s proof of his affection for his country which he

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<sup>197</sup> John William Thomas to George Biddel Airy, October 2, 1839, *Arfonwyson Letters*, National Library of Wales, item 30.

<sup>198</sup> MacDonald, "Isaac Roberts, E.E. Barnard, and the Nebulae," 239.

<sup>199</sup> Original text: "Credwn yr eddyf pawb mai hwn yw un o'r seryddwr mwyaf, os nad y mwyaf oll, a fagodd Cymru erioed." Evans, *Seryddiaeth a Seryddwr*, 276.

<sup>200</sup> Eleazar Roberts will be discussed more in depth in chapter three.

<sup>201</sup> Evans, *Seryddiaeth a Seryddwr*, 276.

loves constantly, he is a Welshman to the tips of his fingers - he left a princely sum to the colleges of Cardiff, Bangor, and Liverpool.”<sup>202</sup> Roberts and Thomas demonstrate the Welsh connections that some astronomers maintained after leaving the Principality. As wealthier individuals, they possessed the means to bring scientific education to Wales. However, non-wealthy astronomers also gained prominent social status and cultural authority.

### **Working-Class Astronomy**

Understanding how working classes gained access to astronomical knowledge and practiced astronomy is crucial to understanding the role of science in Welsh Victorian society. Most working-class astronomers, however, left little or no written material. Chapman has pointed out that most knowledge on working-class astronomy has derived from five types of sources: correspondence letters, letters to periodicals, published journalists’ interviews, diary notes, and obituaries in provincial newspapers.<sup>203</sup> What have been missing are the observing books and exchanges of letters between other peers.

The majority of working-class astronomers were self-taught. John Jones of Bangor serves as an excellent example of working class astronomy because of the sources that have survived that recount his work. Jones devoted all of his free time to the pursuit of astronomy, embodying the working-class serious-leisure astronomer. He displayed the significance astronomy held within local communities, and the ways in which the poor and impoverished gained access to science; Jones did not pursue astronomy for financial gain, but rather for a love of science and with goals of self-enlightenment.

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<sup>202</sup> Original text: “Fel prawf o’i serch at ei wlad, yr hon a garai yn angherddol – yr oedd yn Gymro i flaenau ei fyseidd – gadawodd yn ei ewyllys swm i Golegau Caerdydd, Bangor, a Lerpwl.” Evans, *Seryddiaeth a Seryddwr*, 278.

<sup>203</sup> Chapman, *The Victorian Amateur Astronomer*, 162.



Figure 6.  
Jones with his 8-inch homemade reflecting telescope,  
Jumbo. J. Silas Evans, *Seryddiaeth a Seryddwr* (Cardiff:  
William Lewis, 1923), 273.

It is crucial to understand how their perceptions and actions are filtered through the upper and middle classes who wrote articles on these individuals. Jones' work has mostly been conveyed through his interview with Samuel Smiles in his work *Men of Invention and Industry*. Smiles provided excellent insight into the psyche of astronomers in "humble life."<sup>204</sup> Most of his work was concerned with individuals in England, but he also travelled to Bangor to interview the by-then esteemed working-class astronomer John Jones in 1884. Smiles only heard of Jones through a friend from Leeds, Reverend Charles Wickstead, who informed him on Jones' activities. Knowledge of Jones' prominence spread not only across Wales, but also to other areas of Britain. Jones fashioned himself as a self-defined poet-astronomer while working his entire life as a slate counter in Bangor. He embodied the connection between astronomy and poetry in

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<sup>204</sup> It is important to be aware of the social/cultural divide that autobiographical accounts crossed. Chapman, 205.



Welsh culture, and furthered narratives of the cultural role of astronomers through his social interactions in Bangor and by publishing Welsh-language poetry.

Jones was born in 1818 into a Welsh-speaking agricultural community in Anglesey and received only the most rudimentary of schooling. He was more isolated than English working-class astronomers because of a language barrier. Jones' spoken English was never actually fluent because daily life in Bangor was conducted in Welsh.<sup>205</sup> Jones was fortunate, however, in that part of his duties as a farm labourer was to saddle the horse of the Reverend Cadwalladr Williams, the Calvinist Methodist preacher of Pen Ceint, Anglesey. Williams possessed an extensive library of Welsh-language books, and it is likely here where Jones began his serious self-education. Jones gained a good reading knowledge of English, along with several other languages. He eventually began to acquire his own dictionaries; at the time of Smiles' interview he possessed 26, most acquired secondhand from Liverpool.

Jones' initial introduction to astronomy was through Eleazar Roberts' translation of Thomas Dick's well-known *The Solar System* into Welsh around 1850.<sup>206</sup> This was one of the first books that presented contemporary astronomical knowledge to a Welsh-speaking audience. Other influential works in his possession included John Herschel's *Treatise on the Telescope* and Denison Olmsted's *Mechanism of the Heavens*. Jones remarked that "[t]he perusal of Sir John Herschel's 'Outlines of Astronomy', and of his 'Treatise on the Telescope', set my mind on fire."<sup>207</sup> Jones learnt introductory astronomy by attending a navigation school in Bangor, and he became interested in telescope making through reading about home-made telescopes in the *English Mechanic*. He was arguably the poorest astronomer to fabricate his own glass mirror for

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<sup>205</sup> Chapman, 209.

<sup>206</sup> Evans, *Seryddiaeth a Seryddwr*, 274.

<sup>207</sup> Samuel Smiles, *Men of Invention and Industry* (London: John Murray, 1890), 366.

his reflecting telescope, earning as little as twelve shillings a week around the time of its construction.<sup>208</sup> Jones reflects the resourceful nature of working-class individuals who sought to produce their own astronomical knowledge. Despite his paltry income as a slate counter, at the time of his interview with Smiles he possessed eight-inch and six-inch reflectors, a four-inch refractor, a marine sextant, an equatorial instrument mounted on a tripod stand, and he was in the process of building his own spectroscope.<sup>209</sup>

A recurring theme in working-class astronomy was its pursuit with no goals in mind of profit or career advancement. Chapman comments on Jones' motivations: "In the great tradition of self-education - be it singing, Biblical scholarship, poetry, or astronomy - these studies seem to have been pursued for a mixture of personal and religious motives."<sup>210</sup> Poetry written by John Jones reveals that he perceived astronomy as a self-enlightening and sublime pursuit that mirrored the awesome visual displays of performers' orreries. His poems reflected the cultural authority that he attributed to his telescope, and acknowledged its ability to transport the observer to new and unique worlds. Some of his poems were published in the *Cambrian Natural Observer* in the 1890s. Members of the Astronomical Society of Wales corresponded with Jones both before the Society was formed and after he was inducted as a member in 1895.<sup>211</sup> Smiles also published English translations of this poetry.<sup>212</sup> The English poems served as a way to enlighten English readers to the prominence of a distinctly Welsh astronomy, self-education, and self-expression to counter stereotypes of Welsh culture as backward and inward-looking.<sup>213</sup>

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<sup>208</sup> Chapman, *The Victorian Amateur Astronomer*, 211.

<sup>209</sup> Chapman, 211.

<sup>210</sup> Chapman, 212.

<sup>211</sup> Letters in envelopes simply addressed to "Seryddwr, Bangor" regularly reached Jones. "John Jones, Seryddwr, Bangor." *Journal of the Astronomical Society of Wales* 1, no. 4 (1895): 35.

<sup>212</sup> Smiles included translations of "The Telescope," "The Comet," and "To a quondam Tailor, now a Slate-teller." Smiles, *Men of Invention and Industry*, 368-369.

<sup>213</sup> Chapman, *The Victorian Amateur Astronomer*, 213.

Jones was not the sole working-man astronomer in Wales during the century, either. Other astronomers “of the same class as Jones” included Thomas Norbury and Rhys Howell.<sup>214</sup> The lives of these working-class astronomers demonstrated that they pursued astronomy as a self-fulfilling and enjoyable leisure activity. Men like Jones did not keep their work private. They worked within their local communities and discussed astronomy with peers. Obituaries often emphasized the local connections of men of science, as well as their efforts to spread science to people in Wales.<sup>215</sup> Jones was reportedly known throughout Bangor and Wales. His own copy of Smiles’ work, and the chapter on himself, was incredibly worn and dirty, suggesting that he showed it to everyone he knew.<sup>216</sup> Virtually every resident of Bangor knew John Jones as “The Astronomer” and his social involvement in the north Wales town reflected broader notions of the social authority that practitioners of science wielded in the nineteenth century.

Working-class astronomers embodied the belief that astronomy was as much a cultural practice as a scientific one. Irish astronomer and mathematician William Rowan Hamilton once remarked, “[a]stronomy, though a science, and an eminent one, is yet more than a science, - that it is a chain woven of feeling as well as thought – and influence pervading not the mind only, but the soul of man.”<sup>217</sup> Hamilton’s comments paralleled Welsh astronomers’ perceptions of their practice. Astronomy meant much more to these individuals; it was not just a casual activity or a form of entertainment, it was intertwined with the pursuit of knowledge and self-improvement

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<sup>214</sup> Unfortunately, none of their work has survived, save for Evans’ mention of their prominence in his book. Original text: “Seryddwr ereill yn perthyn i’r un dosbarth â John Jones oedd Thomas Norbury a Rhys Howell o Ferthyr.” Evans, *Seryddiaeth a Seryddwr*, 274.

<sup>215</sup> Referring to Grove. Morus, *William Robert Grove*, 136.

<sup>216</sup> I am grateful to James Secord for sending me a copy of Jones’ own personal copy of *Men of Invention and Industry* from 1884.

<sup>217</sup> Brendan Scaife, ed. *The Mathematical Papers of Sir William Rowan Hamilton* (Cambridge: Cambridge University Press, 2000), 664. Cited in Daw, “The Victorian Poetic Imagination and Astronomy,” 14.

and formed a fundamental element of what it meant to be Welsh during a period when a distinct Welsh identity truly emerged.

### **Local Societies and Public Astronomy**

Local scientific societies and institutions were geared towards different publics. As Morus argues, “some radically different ideas about what science was, what kinds of people its practitioners should be, and what sort of science was appropriate for different social classes, were implicit (and sometimes explicit) in these various forms of scientific organisation.”<sup>218</sup> Scientific institutions were crucial to the development of astronomy in Wales. They must be considered in terms of their organization, goals, members, and intended audiences. Local scientific societies also reveal astronomy’s social significance. Societies invited lecturers to their institutions, while they sometimes published their own periodicals. The Astronomical Society of Wales was Wales’ first society devoted solely to astronomy, but the members of numerous smaller societies discussed astronomical topics throughout the century. These included the Merthyr Literary and Scientific Society and the Royal Institution of South Wales, and along with the Astronomical Society of Wales they aimed to consume and produce astronomical knowledge by publishing members’ work and promoting consistent discourse on astronomical topics.

Local, national, and international astronomical developments were conveyed in the Welsh press. One example is provided by observations on the “great Comet of 1811,” where M. Schroeter’s observations were published which disputed over on the actual length of the comet’s tail.<sup>219</sup> Newspapers often featured the newest debates, discoveries, and publications on astronomy. In one article from 1838, the *Merthyr Guardian* reported, “The Leipsic [*sic*] Gazette

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<sup>218</sup> Morus, *William Robert Grove*, 27.

<sup>219</sup> “Astronomy,” *Cambrian*, August 9, 1817, <http://newspapers.library.wales/view/3323935/3323939/16>.

announces that the new number of Schumacher's *Astronomical Notes* contains a discovery, made by Dr Encke, professor of astronomy at Berlin, that the planet Saturn has three rings instead of only two, as hitherto believed."<sup>220</sup> The work of astronomers was not exclusive to a bounded scientific community; astronomy operated within a larger social framework, where the broader public was a major audience interested in the latest astronomical developments.

Newspaper accounts also informed readers on new astronomical instruments. Chevalier Theodore Carezzini's invention of "two kinds of round tables, which he calls geocentric, and heliocentric tables" were highlighted in the scientific notices of the *Cambrian* in 1821. These tables were advertised as being extremely useful to any astronomer or individual interested in learning astronomy. The article explained, "By their aid, a person without any knowledge of mathematics can, in a very short time, thoroughly observe the course of the stars, and explain the celestial phenomena."<sup>221</sup> Despite numerous accounts of new inventions and astronomical tools, the production of such instruments seems to have rarely occurred in Wales itself. Rather, individuals had to travel to England to obtain telescopes and other astronomical paraphernalia.

The construction of new observatories and telescopes drew attention and excitement from news sources. The success of astronomy was measured by the number of astronomers operating their own observatories. As one author noted, "the great progress of Practical Astronomy in this country may be fairly estimated by the rapid increase in the number of Private Observatories."<sup>222</sup> Observatories were compared to others being built throughout Britain and Ireland. At the King's College, Aberdeen, in 1828, the *Cambrian* informed readers that there was "an instrument in

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<sup>220</sup> "Chit Chat," *Glamorgan Monmouth and Brecon Gazette and Merthyr Guardian*, January 20, 1838, <http://newspapers.library.wales/view/3632240/3632244/26>.

<sup>221</sup> "Literary and Scientific Notices," *Cambrian*, January 13, 1821, <http://newspapers.library.wales/view/3324800/3324804/13>.

<sup>222</sup> W.A. Darby, *The Astronomical Observer: A Hand-Book to the Observatory and the Common Telescope* (London: Robert Hardwicke, 1864), xi.

progress which will no doubt ultimately prove of great advantage to the science of astronomy, especially if similar instruments be erected in other places.”<sup>223</sup> New instruments were described in great detail. The depth of information given suggests that most readers had a general understanding of astronomy and various astronomical instruments. One description of the new observatory at King’s College evidences this intense level of detail:

In the eastern tower of the College a new staircase has lately been formed. In the centre of this new staircase has been placed an iron tube of one foot diameter, of about seven feet long, reaching up to the observatory on the top of the tower. At the bottom of this tube will be placed a mirror, constructed by the celebrated Ramadge, who constructed the large reflecting telescope now to be seen at Greenwich Observatory. At the top of this tube will be placed an eye-piece of the usual construction for reflecting telescopes. The whole instrument will, it is anticipated, form a telescope of powers exceeding all others ever yet made ... The powers of a reflecting telescope depend on the focal distance of the mirror from which the objects are reflected, or as men of science are aware, on the focal distance of the reflecting mirror divided by the focal distance of the eye-piece. This new instrument, then, will give a magnifying power for inspecting far back into the heavens, beyond any thing [*sic*] that has hitherto been thought of, and will therefore increase proportionately the probability of future discoveries. Of course the instrument will only point to the zenith; but then the whole circle of the heavens, constituting the zenith of the place, will in the course of 24 hours, have gradually passed over its disk... The smallest change of the place of any of the stars may be most easily observed. This is a point of discovery to which the attention of Astronomers is at present much directed... It is expected that the success of this new instrument will be sufficient to incite other scientific bodies to take advantage of far loftier towers to construct instruments of greater power, by which the most delicate observations may be made with increased accuracy, and our knowledge extended of the nature of the heavenly bodies, of their motions, and particularly of the “fixed” stars, which are now known to be only fixed in comparative degree. The scientific public will look with much interest for the result of this experiment.<sup>224</sup>

Debates over the quality of telescopes often included their ability to contribute to the ongoing extraterrestrial life debate. Michael Crowe asserts that in the eighteenth and nineteenth centuries three quarters of the most prominent astronomers, and half of the most prominent

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<sup>223</sup> “Interesting Notices: New Astronomical Instrument,” *Cambrian*, October 25, 1828, <http://newspapers.library.wales/view/3326825/3326827/4>.

<sup>224</sup> “Interesting Notices: New Astronomical Instrument.”

intellectuals wrote books, essays, articles, and reviews concerning extraterrestrial life. The concept of pluralism was used by intellectuals such as Immanuel Kant and Thomas Wright to translate religious into physical descriptions. The issue of life on other worlds pervaded most astronomical work and astronomers were aware of the ongoing plurality of worlds debate.<sup>225</sup>

After the construction of the Earl of Rosse's Leviathan in Ireland, debates sparked in Wales over the potential of the monumental telescope to find extraterrestrial life. Specific focus was given to Rosse's observations of the moon. One report discussed the question of extraterrestrial life:

On its surface were craters of extinct volcanoes, rocks and masses of stone almost innumerable. [Rosse] had no doubt whatever that, if such a building as he was then in were upon the surface of the moon, it would be rendered distinctly visible by these instruments. But there were [*sic*] no sign of habitations such as ours- no vestiges of architectural remains to show that the moon is or ever was inhabited by a race of mortals similar to ourselves. It presented no appearance which could lead to the supposition that it contained anything like the green fields and lovely verdure of this beautiful world of ours. There was no water visible - not a sea, or a river, or even the measures of a reservoir for supplying town or factory; all seemed desolate... Was it a lost world? Had it suffered for its transgression? Analogy might suggest the question - Had it met with the fate which Scripture told us was reserved for our world?<sup>226</sup>

In Wales, articles discussed the possibility of life on other worlds and often argued in favour of the existence of extraterrestrial life. One example comes from the *Cambrian* in 1838, where one author asserted that Mars' and Venus' atmospheres were proof of life on the planet. Venus' thick atmosphere was "especially conspicuous," while observations of the planet's evening and morning twilights were used to emphasize its likeness to earth.<sup>227</sup> The article concluded that "the

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<sup>225</sup> The question of pluralism influenced the most prominent astronomers. Crowe argues that it may be the reason that William Herschel studied astronomy and that is comprised a "core component" of his research program. Michael J. Crowe, *The Extraterrestrial Life Debate: Antiquity to 1915* (Notre Dame: University of Notre Dame Press, 2008), 130.

<sup>226</sup> "The Moon in Lord Rosse's Telescope," *Cardiff and Merthyr Guardian Glamorgan Monmouth and Brecon Gazette*, July 11, 1846, <http://newspapers.library.wales/view/3088738/3088740/12>.

<sup>227</sup> "Are the Planets Inhabited?" *Cambrian*, April 14, 1838, <http://newspapers.library.wales/view/3329265/3329269/24>.

planets are worlds fulfilling, in the economy of the universe, the same functions, and created by the Divine hand for the same moral purpose, and with the same destinies as the earth.”<sup>228</sup> For many publishers, the existence of extraterrestrial life was a forgone conclusion.

Often, debates over extraterrestrial life turned to natural theological answers. Studying astronomy was perceived by journalists as a key to answering existential and religious questions. One article noted, “By the light of astronomy the sun is viewed, not merely as a luminary suspended in the heavens, but as the centre of a system of worlds and the source [*sic*] of light and heat, of motion and harmony to them all.” Through the “revealed theology” one could observe the works of the Creator, “shedding his beams to bless dependent worlds and bathing the whole in the effulgence of his loveliness and glory.”<sup>229</sup> Astronomy was often connected to broader religious convictions and practices by lecturers and astronomers alike.

Daily, newspapers printed potential astronomical objects and events for readers to observe either with a telescope or by the naked eye. The majority of readers did not own telescopes, but newspaper articles emphasized that that did not exclude them from observing. In 1824, the *North Wales Gazette* published “The Comet,” an article detailing the viewing of comets from various observatories in England, such as at the Gosport Observatory in Southampton. Readers were advised of one particular comet that could be easily viewed by “those who are engaged in the science of Astronomy.”<sup>230</sup> In addition to comets, the visibility of the planets was a consistent topic where newspapers advised readers on their current movements. The “configurations of the planets during the present and ensuing week” was commonplace in

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<sup>228</sup> “Are the Planets Inhabited?”

<sup>229</sup> “American Theology,” *North Wales Chronicle and Advertiser for the Principality*, December 10, 1833, <http://newspapers.library.wales/view/4459735/4459739/30>.

<sup>230</sup> “The Comet,” *North Wales Gazette*, January 22, 1824, <http://newspapers.library.wales/view/3873555/3873559/30>.



newspapers, and reports were often accompanied by weekly poetry excerpts.<sup>231</sup> All one needed to view the planets was a copy of the local newspaper in order to track the movements of Mercury, Venus, Mars, Jupiter, and Saturn, including their vicinity to one another, and the best hours for naked-eye observing. For example, in 1828 the *Cambrian* included in its news section an article on astronomy. It stated:

ASTRONOMY.- The planet *Jupiter* is now in a most favourable position for observation of his belts and satellites, being not less than 190 millions of miles nearer to the earth than he will be in November next. *Venus* on Tuesday attained her greatest eastern elongation: she is grouped with the planet Saturn, and the fixed stars Castor and Pollux; which, together, form an interesting quadrilateral figure, in shape of a trapezium.<sup>232</sup>

Astronomy was described in an illustrative manner similar to lectures. In their articles, journalists painted picture of sublime scenes for their readers to experience and encouraged them to observe the heavens themselves. Columns and reports on possible weekly and monthly sightings were common in the *Cambrian* and other Welsh newspapers for much of the century.

Through social interactions with others interested in astronomy, journal publications, and proceedings from different societies, astronomers had a general idea of the work they were expected to be undertaking. There was “a tacit understanding between the professional and the amateur astronomers,” where the “amateurs” were to be focused on tracking and charting specific objects. These objects included sun spots, the moon (“with especial reference to indications of change on her surface”), eclipses, planets, comets, double stars not included in catalogues, binary stars, nebulae, and variable stars.<sup>233</sup> New printed material and newspapers persuaded more individuals to practice astronomy and participate in a community that emphasized cooperation and social interaction where novices could contribute.

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<sup>231</sup> [No Title], *North Wales Gazette*, October 6, 1825, <http://newspapers.library.wales/view/3873995/3873999/40>.

<sup>232</sup> “Swansea, Friday, May 23,” *Cambrian*, May 24, 1828, <http://newspapers.library.wales/view/3326715/3326718/8>.

<sup>233</sup> Darby, *The Astronomical Observer*, xi.

Members of Mechanics' Institutes believed that the opening of science to the broader public was a benefit to society. One writer to the editor of the *Monmouthshire Merlin* stated that:

Until the present epoch, the sciences have been the patrimony of a few; but they are already become common, and the moment approaches in which their elements, their principles, and their most simple practice will be really popular. Then it will be seen how truly universal their utility will be in their application to the arts, and their influence on the general rectitude of the mind.<sup>234</sup>

In response, the author noted his regrets that Monmouth lacked any type of scientific society, "having for its objects the dissemination of knowledge and the promotion of science among the humbler portion of the community."<sup>235</sup> He believed that scientific knowledge would be useful to the lower classes, and would also benefit tradesmen and workers.

Articles promoted science as a supplement to religion to advertise its practicability. One author stated that "the influence of knowledge... in promoting morality and religion; and I fervently hope, that if this appeal should attract the attention of any of our ministers of religion, they will come forward and lend their aid in promoting so desirable an object, and by so doing advance the cause of Him whose servants they are." The "sublime system of religion" was especially linked with astronomy's sublime displays and illustrative lectures occurring during the midcentury. Specific attention was given to astronomy:

We will next turn our attention to astronomy, which is the most pure and refined system of mechanics that can possibly be conceived, and the most perfect and interesting of the sciences. No study will have a greater tendency to enlarge the mind, or inspire just notions of the wisdom, the power, and the goodness, of the Supreme Architect. 'If one train of thought' says the late distinguished theologian, Dr. Paley, 'be more desirable than another, it is that which regards the phenomena of nature, with a constant reference to the supreme intelligent Author. To have made this the habitual sentiment of our minds, is to have laid the foundation of everything which is religious. The world, from thence, becomes a temple, and life itself one continued act of adoration'.<sup>236</sup>

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<sup>234</sup> "Mechanics Institutions," *Monmouthshire Merlin*, September 7, 1839, <http://newspapers.library.wales/view/3393010/3393014/48>.

<sup>235</sup> "Mechanics Institutions."

<sup>236</sup> "Mechanics Institutions."

Astronomy was advertised as a tool for self-improvement. The boundaries of the emerging scientific community were porous during the century which enabled new audiences to consume and produce scientific knowledge, enter into current scientific discussions, and maintain status as a member of an emerging national scientific network. Local publics were able to participate in science first by attending astronomical lectures, then by following news reports on astronomy and possible viewings. By the midcentury, the establishment of scientific societies created new spaces for local scientific discourse to flourish. Instead of a temporary space for scientific learning, such as an evening spent at a lecture, scientific societies became permanent sites for the consumption of astronomical knowledge and aided the dissemination of new material with their own journals, libraries, and connections with other provincial societies.

### **The Royal Institution of South Wales**

The Royal Institution of South Wales, based out of Swansea, was the pre-eminent scientific society in Wales and featured many prominent scientific individuals. While there was no purely astronomical institution until the founding of the Astronomical Society of Wales, local societies like the Royal Institution contained many practicing astronomers and promoted astronomical discussions. The Institution not only invited speakers to educate members, but also reproduced the content of lectures in various newspapers for wider audiences. There were a few motivations for these actions: first, reports acted as an advertisement for new members. Second, along with summaries of lectures, publications included society members' correspondences.<sup>237</sup>

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<sup>237</sup> "Royal Institution of South Wales," *Welshman*, January 29, 1841, <http://newspapers.library.wales/view/4345224/4345228/34>.

This allowed readers who were not members to participate in scientific discourse and helped establish science as an everyday topic of discussion.

But the Royal Institution was not the first scientific society in Swansea. Rather, the Institution was the result of three decades of work from smaller groups in their efforts to create a hub for scientific learning. In the first decades of the nineteenth century, local dignitaries in Wales donated collections of scientific instruments as well as books for libraries. There were two circulating libraries in the early nineteenth century, and by 1808 there was a public subscription library whose proprietors included Lewis Weston Dillwyn. Swansea also had a prominent book trade that was advertised in the *Cambrian* as early as 1807 and maintained a reading society since the 1780s.<sup>238</sup> The Institution in Swansea played a key role in establishing the reputation of the town as a commercial and cultural centre. In Wales, like elsewhere in Britain, scientific societies reflected a town's metropolitan aspirations and its claims as a cultural authority.<sup>239</sup>

A primary motivation was to rival Bristol as a scientific metropolis, with goals of creating an urban institution to enhance urban status and extend regional influence. This is especially significant within the context of the smaller populations of principal Welsh towns compared to those in England.<sup>240</sup> By 1841, Wales had 6 towns with a population of 8,000 or

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<sup>238</sup> The Swansea area was likely one of the most literate in Wales during the early nineteenth century. This is partly attributed to the foundation of the Welsh circulating schools by Griffith Jones (the vicar of Llanddowror, Carmarthenshire) between 1737 and 1777. Ralph Griffiths asserts that this was the first breakthrough in Wales towards large-scale literacy and that Jones' schools taught as many as 400,000 adults and children to read. The schools were free, widely circulated, and Swansea was a target area during the first decades of the schools' existence. Morus, *William Robert Grove*, 14; Griffiths, *The City of Swansea*, 14-25. Geraint Jenkins argues that Jones' efforts not only increased literacy but also strengthened the Welsh language. For a map of every circulating school in Wales by 1757, see Jenkins, *A Concise History of Wales*, 162.

<sup>239</sup> Morus, 14.

<sup>240</sup> Despite being in England, Bristol was the closest thing to a "metropolis" near Wales, and before Swansea's emergence those interested in science would often travel to England. For more on Bristol's status as a scientific metropolis in the nineteenth century, see Michael Neve, "Science in a Commercial City: Bristol 1820-60," in *Metropolis and Province*, 179-204.

more: Caernarfon, Cardiff, Carmarthen, Merthyr Tydfil, Newport, and Swansea.<sup>241</sup> The Royal Institution of South Wales was viewed by newspapers and practitioners of science as a flagship of Swansea's growing influence and reputation as a centre for commerce and urban culture.<sup>242</sup> Swansea was a fast-growing Welsh town that emerged out of Bristol's shadow.

Swansea's scientific institution was first founded in 1835 and renamed the Royal Institution of South Wales in 1836. Its founders, including Lewis Weston Dillwyn, remarked that, "it had long been a matter of surprise and regret that a large, intelligent and populous town like Swansea ... should be without some institution of this kind."<sup>243</sup> Dillwyn's role cannot be overemphasized. In his 1855 biography, Soranus concluded that "he actively exerted himself to raise the noble edifice, and effectually to establish the Royal Institution of South Wales, of which he has been the president from its foundation up to the period of his lamented death."<sup>244</sup> The rise of Swansea's scientific elite paralleled newspaper reports on the meetings of scientific societies in the 1830s.<sup>245</sup> The Royal Institution demonstrated Swansea's growing regional influence, and the social power that scientific institutions wielded.

With the establishment of science societies came the addition of new libraries offering material for those interested in learning science. The Jesus College in Oxford was instrumental in setting up a library near Swansea that would be connected to its local literary and scientific society. The library was geared towards citizens seeking to learn more on religious topics as well

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<sup>241</sup> During the first half of the century Swansea was Wales' most populous town with a population of over 6,000 by the 1801 census, and a population of 31,139 by 1851. By 1901, Swansea's population totaled 94,537. Davies, *A History of Wales*, 319; Griffiths, *The City of Swansea*, 27.

<sup>242</sup> Miskell, "The Making of a New 'Welsh Metropolis'," 32.

<sup>243</sup> Miskell, 35.

<sup>244</sup> Soranus, *The Science and Scientific Men of Wales*, 20.

<sup>245</sup> Newspapers reported on BAAS meetings. One example is from 1838 when the BAAS gathered in Newcastle. An article from the *Cambrian* asserted that Newcastle was, "until the last few years, a large uncultivated portion of ground," but it "became the area of the most remarkable enterprize [*sic*]." Swansea experienced a similar development. "The Newcastle Meeting of the British Scientific Association," *Cambrian*, September 1, 1838, <http://newspapers.library.wales/view/3329365/3329369/23>.

as astronomy and geology.<sup>246</sup> Large crowds gathered in full town halls to attend lectures, but smaller sites at scientific societies offered a different experience. Local societies provided a more intimate atmosphere which enabled further “intellectual exploration.”<sup>247</sup> The Institution was to become an important instrument of status enhancement for both Swansea and society members.

The Royal Institution immediately began to link with other societies in Britain and promoted scientific discourse in Wales. The annual report of the Institution in 1836, after a year of operation, stressed that Swansea’s recent growth aided the development of the Institution and vice versa. Swansea’s wealthier residents perceived a local scientific society as mutually beneficial for all the town’s inhabitants. The report emphasized that “numerous connexions with foreign parts” provided “so many advantages for the encouragement and propagation of scientific research.”<sup>248</sup> The success of the Royal Institution prompted the formation of societies in other townships. The Neath Museum and Society for Promoting the Arts and Sciences was established in 1835 and the Merthyr Literary and Scientific Institution was established in 1837.<sup>249</sup> Members aimed to create influential institutions that furthered scientific research and establish connections with the broader emerging scientific community.

The Royal Institution’s influence was also crucial for the hosting of the British Association for the Advancement of Science’s (BAAS) annual meeting in Swansea in 1848. Swansea’s history as a resort town aided the Royal Institution’s efforts to bring the BAAS to Wales.<sup>250</sup> By inviting the BAAS to Swansea, the Royal Institution made a deliberate and explicit

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<sup>246</sup> “Varieties,” *North Wales Chronicle and Advertiser for the Principality*, March 19, 1829, <http://newspapers.library.wales/view/4461110/4461111/2>.

<sup>247</sup> Chapman, *The Victorian Amateur Astronomer*, 174.

<sup>248</sup> Miskell, “The Making of a New ‘Welsh Metropolis’,” 43.

<sup>249</sup> Morus, *William Robert Grove*, 15.

<sup>250</sup> Swansea was a prominent resort town in Wales from the 1780s. Bathing became a popular activity among travellers and the natural advantages of Swansea’s beaches drew many English tourists. For more on resort towns in Wales in the nineteenth century, see Peter Borsay, “Welsh Seaside Resorts: Historiography, Sources, and Themes,” *The Welsh History Review* 24 (2008): 93-119; John Hassan, *The Seaside, Health, and the Environment in England*

signal of the town's ambitions to show Britain that Swansea boasted a strong scientific community. The popularity of resort towns meant that Swansea already had substantial means to host a BAAS meeting because of the numerous accommodations where members could board.

However, travelling to Swansea in 1848 was a problem. The rail link between Gloucester and Swansea was not built until after 1850. Instead, BAAS members could take a mail coach along the coast, or take a train to Bristol and a boat to Swansea. A mail coach leaving London at 8:55p.m. got to Swansea the next day at 1p.m.<sup>251</sup> Critics questioned whether going to Wales was a fruitful endeavor. One critic voiced his complaints, slating Swansea as, "remote from the Metropolis; remote from the chief seat of English learning; remote, also, from those great highways of communication... the highways of steam."<sup>252</sup> Nevertheless, Swansea's most prolific scientific practitioners assured that the BAAS meeting was a success in south Wales.

Despite critiques from BAAS members over the inaccessibility of Swansea, the meetings achieved consistent success and displayed that Wales was as scientifically inclined as England. In his opening remarks, the President stated that unless the BAAS had "come to Swansea itself, or to some other place in South Wales, South Wales would have remained unvisited." The event was billed as the "most important in the recent history of the Principality." The attendance of 847 members was comparable to previous meetings in Southampton and York, and higher than those in Cork and Plymouth.<sup>253</sup> Swansea was similar to other urban centres in England, and the Royal Institution helped to cement Swansea within a growing network of provincial scientific societies.

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*and Wales since 1800* (London: Routledge, 2016), 15-74; Peter Borsay and John K. Walton, ed. *Resorts and Ports: European Seaside Towns Since 1700* (Bristol: Channel View Publications, 2011), 86-125.

<sup>251</sup> Griffiths, *The City of Swansea*, 1.

<sup>252</sup> Griffiths, 1.

<sup>253</sup> Miskell, "The Making of a New 'Welsh Metropolis'," 46.

Lewis Weston Dillwyn and William Robert Grove served as strong advocates in persuading the BAAS to come to Swansea in 1848. The 1848 meeting was far more successful than when the BAAS returned to Swansea in 1880. That meeting was generally regarded by attendees as being less successful than the first, despite the consistent growth of the Royal Institution's membership during the 32 years between visits. Grove and Weston Dillwyn, along with others such as de la Beche and Benson, were all involved in the Royal Institution and vocal in their support for Swansea's scientific potential. However, by 1880 de la Beche, Benson, and Dillwyn had all died, while Grove had moved out of science and into politics. This left Swansea "sadly deficient in local men of scientific tastes with sufficient leisure time to devote to the study;" the rise of Swansea as an industrial centre and its diminishing reputation as a resort town also contributed to its image as a less-picturesque location for the BAAS conference.<sup>254</sup>

Science societies were made up of members from diverse backgrounds and no society excluded members because of their social background or gender. The Royal Institution of South Wales inducted women members from its formation. The Institution stated that, "each subscriber may introduce all the females and minors of his own family." By 1839 there were at least eight independent female subscribers.<sup>255</sup> The admittance of women and family members aligned with other groups in Britain at this time; the BAAS also encouraged members (all were men) to bring their wives. The admittance of women reflected science being a social, often familial, activity. Women's interest in astronomy did not go unnoted, either. A group of women were noted for their interest in the extraterrestrial life debate, and they specifically focused on debating the idea of life on the moon.<sup>256</sup> Women were considered as legitimate consumers of astronomical

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<sup>254</sup> Miskell, 50.

<sup>255</sup> Miskell, "The Making of a New 'Welsh Metropolis'," 39.

<sup>256</sup> "Varieties," *Pembrokeshire Herald and General Advertiser*, January 24, 1845, <http://newspapers.library.wales/view/3051868/3051872/34>.



knowledge, as astronomy was perceived by society members as a leisure activity that could be practiced by everyone. By the late century, decades of local scientific society work led to the establishment of Wales' first national society devoted wholly to astronomy.

### **Astronomical Society of Wales**

The formation of the Astronomical Society of Wales in 1895 represented the culmination of a century of astronomical work. The efforts of individuals involved in small scientific societies connected them with other local groups and they expressed a desire to form a national astronomical society. Meetings were held in Cardiff, but the Society aimed to have representation from across Wales, appointing sixteen Vice-Presidents from various regions.<sup>257</sup>

Arthur Mee played a key role in the establishment of the Society, serving as its first President as well as the editor of its journal.<sup>258</sup> Mee later noted in his diary the early discussions over the formation of an astronomical society:

I asked one of Cardiff's most eminent astronomers whether it would be possible to found an Astronomical Society there. He feared it would be impossible. A little later, Mr. Norman Lattey came to me to enquire further on the subject, with the result that we called a meeting [in Cardiff] at the end of 1894, and the Society was formed. The gentleman who feared the society could not be formed became one of its presidents. Later its membership numbered 200.<sup>259</sup>

Despite initial fears from members that an astronomical society would fail, during the first month of its existence the Society's journal remarked that support for a purely astronomical society was growing. The first issue of the journal commented, "[t]hat a Society such as ours is a real want in Wales is evident from the hearty manner in which the proposal has been taken up. Our

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<sup>257</sup> Bryn Jones, "Astronomical Societies," accessed February 14, 2018, <http://www.jonesbryn.plus.com/wastronhist/astrosocs.html>.

<sup>258</sup> The journal was first titled the *Journal of the Astronomical Society of Wales*, but was renamed the *Cambrian Natural Observer* in 1898.

<sup>259</sup> Evans, *Seryddiaeth a Seryddwr*, trans. Rhys Morris, 279-280. Cited in Bryn Jones, "Astronomical Societies."

membership is already 60 strong, and we hope soon to attain the century!” The first 60 members had “long been practical observers” and 22 new members were admitted after the first month. Mee even boasted that new members were being admitted on a near-daily basis.<sup>260</sup>

Additionally, newspapers reported on the establishment of the Society and its popularity. The *Evening Express* described the “encouraging progress” of the new society and listed the ten new members that were elected in April of 1895.<sup>261</sup> The formation of the Astronomical Society of Wales represented a movement to legitimize the work of Welsh astronomers and create a space for consistent and frequent astronomical discourse, while also connecting them to other provincial societies in Britain, Europe, and America.

The goals of the Society combined educational measures with the desire to publish and discuss new papers and observations. The first question asked by Mee to the Society’s members was “[w]hat can we do?” and he aimed to quell any fears held by beginners:

The thought that many people are deterred from the pursuit of Astronomy because they imagine its study demands on the one hand profound Astronomical knowledge, and on the other possession of costly and elaborate appliances. They seem to think that a student of the stars must be of necessity a Newton, a Laplace or an Airey [*sic*], and have at his command a telescope like that of Lord Rosse, or an equipment like that of Greenwich or Mount Hamilton! Happily, we members of the Astronomical Society of Wales are not quite so ambitious as this, nor have we so curious an idea of the science... it will be one of the objects of our Society to assist beginners in the choice and the purchase of telescopes.<sup>262</sup>

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<sup>260</sup> *Journal of the Astronomical Society of Wales* 1, no. 1 (1895): 1.

<sup>261</sup> “Astronomy. Welsh Society Reports Encouraging Progress,” *Evening Express*, April 27, 1895, <http://newspapers.library.wales/view/3253054/3253057/76>.

<sup>262</sup> Mee, “President’s Address,” 5.

“Celestial literature” was much more available to both English and Welsh readers by the last decade of the century and coincided with the rise of cheap telescopes. Moreover, the growth of astrophotography and “readable treatises” meant that it was easier to learn astronomy than ever before. The Society aimed to accomplish “really useful work.”<sup>263</sup> Some tasks included identifying star groups, mapping planets, meteors, and constellations, undertaking new research, and promoting the discussion of astronomy across Wales. The Society’s members also introduced the use of spectroscopes and papers on spectroscopy were considered as the “most important” items during meetings. Discussions during monthly meetings revolved around teaching other members the “principles of spectrum-analysis.”<sup>264</sup> The Society desired submissions of original observations and papers, but it also accepted “careful drawings.” All collected material was to be preserved for reference in the Society’s library in Cardiff.<sup>265</sup> The library included the publications from other provincial societies, and books donated by members.



Figure 7.  
The Moon, photographed by G. Parry Jenkins using a 16-inch reflector, February 14, 1891. “The Solar System,” *Journal of the Astronomical Society of Wales* 2, no. 1 (1896): 15.

<sup>263</sup> Mee, 5.

<sup>264</sup> “Astronomy. A Triumph of the Spectroscope,” *Evening Express*, April 11, 1896, <http://newspapers.library.wales/view/3261087/3261090/51>.

<sup>265</sup> *Journal of the Astronomical Society of Wales* 1, no. 2 (1895): 8.

All women were eligible for membership, and they shared the same privileges as men despite paying nearly half the subscription fee. Among the first 60 members, six were women, while female membership totaled as high as 27 by 1910.<sup>266</sup> Every member was permitted to bring a visitor to meetings in order to promote astronomical learning with beginners and other citizens without any prior scientific education.<sup>267</sup> Efforts to increase membership paralleled the Royal Institution’s publishing of lectures earlier in the century. Both societies aimed to disseminate knowledge to a broad audience and reflected the value of communal education in Welsh society.

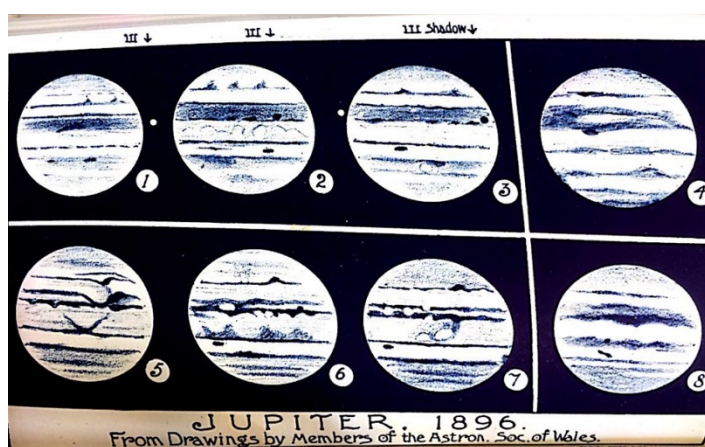


Figure 8.

A comparison of different members’ drawings of Jupiter.

“Jupiter, 1896,” *Journal of the Astronomical Society of Wales* 2, no. 3 (1896): 45.

Members of the Society encouraged beginners to join, regardless of education. New members were not required to own a telescope and the *Cambrian Natural Observer* promoted others’ willingness to teach new observers. One member wrote that, “by and bye we shall tell beginners how, with a couple of spectacle glasses and cardboard tubes, they can see for themselves quite as much as the wonderful “£5 telescope” reveal;” the monthly journal publications contained notes on the current “principal astronomical phenomena, visible chiefly to

<sup>266</sup> *Cambrian Natural Observer* 1, (1911): 60-66.

<sup>267</sup> *Journal of the Astronomical Society of Wales*, iii-iv.

the naked eye.”<sup>268</sup> The Astronomical Society of Wales reflected the reoccurring theme throughout the century of broad, accessible education. The Society was an inclusive group that aimed to further research in astronomy and educate new members.

Mee also helped to promote Wales’ most prominent astronomers and elevate them as cultural idols. Mee often wrote about John Jones, who was increasingly viewed as a working-class hero throughout Wales. After Jones’ death in 1898, Mee published a long obituary in the *Cambrian Natural Observer*. Jones was known simply as “*Seryddwr*,” or Astronomer.<sup>269</sup> Mee portrayed Jones as an icon of a specifically Welsh style of astronomy. The association of prominent Welsh astronomers with the Welsh language reflected broader notions of Welsh culture. Language connected north and south Wales, cultural myths, legends, and traditions, and astronomy was part of this cultural milieu.

The Astronomical Society of Wales represented a century’s worth of scientific networking and other provincial societies took notice. Societies worked together to help those in Wales collect more astronomical material. Mee commented that, “Even the public journals... have called special attention to our movement, some of them in very favourable turns.” He continued, noting that the “Welsh Press, both North and South, has rendered us valuable service; the London and English Provincial Journals have not been silent, and even in far-off America the new Society has received attention.”<sup>270</sup> Societies donated books and other publications to those in Cardiff, including the journal and memoirs of the British Astronomical Association, the bulletin of the Societe Astronomique de France, and the transactions of the Toronto and Leeds Astronomical Societies. Arthur Mee thanked each donor of materials in the Society’s journal.<sup>271</sup>

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<sup>268</sup> *Journal of the Astronomical Society of Wales*, v.

<sup>269</sup> Chapman, *The Victorian Amateur Astronomer*, 213.

<sup>270</sup> *Journal of the Astronomical Society of Wales*, 2.

<sup>271</sup> Arthur Mee, *Cambrian Natural Observer* 1, no. 1 (1898): 32.

## Conclusions

Ultimately, astronomical activity in Wales flourished over the course of the nineteenth century. Much like in Ireland, a group of extremely influential figures played a key role in establishing an astronomical community in Wales, and astronomy experienced a surge in popularity. John Jones, the Dillwyns, and Arthur Mee did not boast the same prolific resumes as Lord Rosse or John Herschel, but nevertheless were crucial to the spread of scientific culture in Wales. The Dillwyn Llewelyn family helped create the Royal Institution of South Wales and transformed Swansea into a scientific hub that promoted communal discourse and cooperation. The Royal Institution played a key role in bringing the BAAS to Swansea in 1848, which helped to advertise Wales' new scientific identity to the rest of Britain.

Astronomy was practiced primarily as a serious leisure activity with goals of self-enlightenment, communal interaction, and cultural expression. John Jones reflected the cultural significance of astronomy as a working-class practitioner in north Wales. His poetry reflected the prominence of astronomy in Welsh society as a proto-romantic pursuit that enabled observers of the heavens to experience the sublime. Jones benefitted from the increase in Welsh astronomical material. Astronomy's cultural role was further emphasized in many forms through different publications that expanded throughout the century and enabled Welsh readers to access new sources for the consumption of scientific knowledge. Books, journals, and periodicals played a major role in depicting astronomy as a thoroughly *Welsh* activity that was pursued by the most prolific members of Welsh society for its religious, educational, and practical benefits.

### Chapter 3

#### “of Celtic derivation”: Astronomical Publications and the Production and Consumption of Scientific Knowledge

During the first half of the nineteenth century, the lack of scientific literature in Welsh was a matter of great concern to many scientific men in Wales. The chemist and literary historian Thomas Stephens doubted whether Welsh people were reading any scientific publications when he lamented the lack of Welsh-language material:

What about the country’s scientific literature? We do not have one! We have an essay or two on Astronomy; a translation from the Christian Philosopher; a book on Chronology by Lloyd; and another on Geography by Mr J. T. Jones; and that is all ... knowledge of this kind is not available anywhere to the Welshman except in *Y Wawr*, and in the Welsh Chambers.<sup>272</sup>

However, Stephens’ comments were seriously out of place. By 1851, when he wrote, there were over 100 Welsh-language technical books and several hundred scientific periodical articles. One possible explanation is that Stephens did not consider the many periodicals, textbooks, and growing number of lectures as legitimate sources for scientific learning. How practitioners of science perceived “popular” material exhibits the differences in understanding of how best to teach, learn, and practice science. Who published scientific work, how they distributed it, and how readers consumed it reveals the cultural authority that science wielded. I argue that publications forwarded the notion to Welsh readers that astronomy was a cultural tradition that embodied Welsh themes of religious devotion and communal and practical education.

Welsh people’s initiatives for scientific publishing had two distinctive characteristics. First, material was designed to disseminate general information to the wider population. Second, publishers aimed to promote the discussion of scientific topics in Welsh, with specific focus

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<sup>272</sup> Thomas Stephens, “Agwedd Bresennol Lleenyddiaeth yn Nghymru,” *Y Wawr* 2, no. 13 (1851): 62; Stephens himself offered five guineas for the best Welsh translation of a Mrs. Marcott’s “Dialogues on Opticks” in the Abergavenny Eisteddfod, 1848, see *Yr Haul* 13, (1848): 99. Cited in Hughes, “The Welsh Language in Technology and Science,” 417.

given to the connection between science and religion. Authors believed that through reading more about science in Welsh, their articles and books would encourage the reader to learn English.<sup>273</sup> Publishers aimed to bring scientific literature to a previously untapped audience. At mid-century, two out of every three people in Wales spoke Welsh, a total of about 750,000, most of whom had no knowledge of English.<sup>274</sup> Welsh residents were a new audience that craved more scientific literature. They consumed and produced astronomical knowledge differently from readers in England because of the distinctly Welsh characteristics that were attributed to its practice through many mediums of publishing. Periodicals, journals, and books stressed that astronomy was a Welsh tradition through religious and poetic allegories that connected astronomers with myth and folklore as astronomy was inserted into a new Welsh cultural milieu.

### Periodicals

Local scientific societies in Wales played a key role in disseminating astronomical knowledge through periodicals. One publication, edited by T. Lewis and H.P. Hollis, gave a monthly review of astronomy, highlighting the newest work, as well as giving information on telescopes, observatories, and meetings.<sup>275</sup> The annual reports of the Swansea Literary and Scientific Society often included the publications of astronomical papers, such as “Speculations in Astro-Geology.” In it, the author discussed the two sciences and offered facts to support arguments concerning differences between the planets’ axes and orbits.<sup>276</sup> After the

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<sup>273</sup> This was because of the large number of English-language scientific publications. A Welsh-language treatise might introduce the reader to the basics of the sciences, but one needed to read English texts to attain a complete understanding. A.L. Trott, “The Society for the Diffusion of Useful Knowledge in Wales 1848-1851,” *NLJW* 11, no. 1 (1959): 33-75. Cited in Hughes, 405.

<sup>274</sup> Davies, *A History of Wales*, 388.

<sup>275</sup> T. Lewis and H.P. Hollis, ed. *The Observatory: A Monthly Review of Astronomy* (London: Taylor and Francis, 1877).

<sup>276</sup> This included the orbits of Mercury, Venus, Earth, Mars, Jupiter, Saturn, and Uranus, but not newly discovered Neptune. *Annual Reports of the Swansea Literary and Scientific Society* (Swansea: Dryden and Lewis, 1847): 15-31.



establishment of the Astronomical Society of Wales, Arthur Mee discussed the popularity of astronomy. Publishing in the periodical *Wales*, Mee aimed to capture a Welsh audience, insisting that “there must be a very large number of Welsh people who feel a liking for astronomy, and who would be only too glad to be put in the way of knowing more about it.”<sup>277</sup> Readers were often directed to the periodicals of other societies in Britain. One of the most important periodicals by the end of the century was that of the British Astronomical Association, whose publications were emphasized as “of the greatest interest and value” to aspiring astronomers in Wales.<sup>278</sup> Scientific societies were not only centres for astronomical discourse, but also purveyors of new, available, readable scientific material.

Welsh-language periodicals had different challenges and audiences from their English-speaking counterparts. *Y Greal* was the first published in the nineteenth century. Published in 1805, its goals were to publish on “biology ... astronomy ... agriculture, horticulture, tree husbandry, handicrafts and mining.”<sup>279</sup> *Y Greal* emphasized the practical benefits of a scientific education over the course of the century, but readers without any knowledge of English struggled to comprehend the scientific terminology. How to properly translate scientific terminology into Welsh was a primary concern for Welsh-language publishers and translators. Often, publishers would simply list the English scientific term, followed by various Welsh translations. One example comes from the monthly periodical *Goleuad Gwynedd*. Though the periodical featured mainly religious articles and poetry, editor John Parry and poet Evan Evans regularly included an index of newly translated English scientific terms “for the education of the Welsh people.”<sup>280</sup>

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<sup>277</sup> Arthur Mee, “A Plea for the Study of Astronomy,” *Wales 1894-1897* 2, no. 18 (1895): 437, <https://journals.library.wales/view/2187889/2188776/4>.

<sup>278</sup> Arthur Mee, *Observational Astronomy: A Book for Beginners* (Cardiff: Daniel Owen, 1893), 26.

<sup>279</sup> Hughes, “The Welsh Language in Technology and Science,” 416.

<sup>280</sup> Original text: “Yma y canlyn Rhestr o eiriau Saesoneg a Chymraeg er addysg i'r Cymry.” *Goleuad Gwynedd* 4, no. 96 (1826): 518, <https://journals.library.wales/view/2123822/2124365/13>.

Parry's translations for "Astronomy" included *seroni* and *sywedaeth*, which differed from the use of *seryddiaeth*.<sup>281</sup> Publishers solved the question of terminology with different methods to bring scientific knowledge to Welsh readers. Periodicals could use English terms, multiple Welsh translations, or glossaries which helped readers understand the creation of new Welsh words.

One of the first Welsh-language periodicals to give significant attention to astronomy was *Y Brud a Sylwydd*. Discussions included Newtonian philosophy, the planets, sun, moon, light, and eclipses.<sup>282</sup> The astronomer Robert Roberts, writing in 1828, commented that the periodical was the first to publish articles on astronomy for a specifically Welsh audience.<sup>283</sup> The main impetus for the periodical was to produce new scientific definitions in Welsh. In their first issue, the periodical emphasized the serious attempt that was being made "to draw the attention of the Welsh to these sciences."<sup>284</sup> There were concerns over the ability of Welsh speakers to learn science from Welsh sources alone. One author worried that the lack of material was bound to have a negative impact on the well-being of local communities:

If our fellow countrymen are not able, by some means or another, to practise [*sic*] a branch of learning other than what they can acquire from the best publications in Welsh, they can hardly be proficient in dealing with the maintenance and succouring [*sic*] of this life. This is a field which is almost wholly uncultivated in Welsh, although our language is not less adapted than others to making it productive.<sup>285</sup>

The lack of Welsh material meant that translators had a potentially fruitful market to bring English-language translations to Welsh readers.

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<sup>281</sup> *Goleuad Gwynedd*, 519.

<sup>282</sup> "Newtonian Philosophy," *Y Brud a Sylwydd* 1, no. 6 (1828): 129-137, <https://journals.library.wales/view/2141915/2142048/0>.

<sup>283</sup> Robert Roberts, "Seryddiaeth a Daearyddiaeth," 1828, 120-1. Cited in Hughes, "The Welsh Language in Technology and Science," 416; "Seryddiaeth," *Y Brud a Sylwydd* 1, no. 6 (1828): 152-154, <https://journals.library.wales/view/2141915/2142048/23>.

<sup>284</sup> Original text: "Alw sylw y Cymry at y Gwyddorion (*sciences*) hyn." Hughes, 416.

<sup>285</sup> Hughes, 416.

Prominent Welshmen promoted the inclusion of science in more Welsh literature. In his address to the eisteddfod in Swansea in 1841, Reverend John Jenkins argued for increased efforts to produce new material and translations of scientific work into Welsh:

It was an astounding fact, that there was not in the Welsh language a single work connected with the sciences ... He stated that it was strictly necessary that the Welsh artizan should be furnished with scientific works in his own language; and it was on the principle the Committee offered ... prizes for the best translation into Welsh, of the article on the General Properties of Matter and on Mechanics, being the first six lectures in Mrs Marcet's Conversations on Natural Philosophy [prize £15] ... [this] would have a tendency towards inspiring Welshmen with a desire for a knowledge of the [English] language.<sup>286</sup>

However, attendees at the eisteddfod replied to this criticism. One writer to the editor of the *Cambrian* the following week argued against Jenkins' statements:

I feel so ashamed that such an assertion could have been made by any man who professes to read Welsh... I have always been taught that astronomy, geography, and medicine, has *something to do with the sciences!!!* and that the difficulty in my mind is to name the science on which there is *not* any thing [*sic*] written in the Welsh language... In justice to my country, I must say that either the speech in question has been erroneously reported, or that the speaker has not explored much in the field of Welsh literature.<sup>287</sup>

Tensions between English and Welsh speakers reveal that some scientific literature was not always considered legitimate. Welsh periodicals were “the peasant literature of Wales,” or something belonging to “uneducated” common people, yet Welsh readers highly valued these publications.<sup>288</sup> The negative views associated with the Welsh language created a perception among English-speaking contemporaries that there was no Welsh literature on science.

The first translations of English-language astronomical works appeared in the 1830s in the form of short pamphlets and articles. The famous *Moon Hoax* was translated into Welsh as a

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<sup>286</sup> “Druidic Eisteddfod,” *Cambrian*, August 28, 1841. Cited in Hughes, 418.

<sup>287</sup> “To the Editor of the *Cambrian*,” *Cambrian*, September 11, 1841, <http://newspapers.library.wales/view/3330150/3330153/14>.

<sup>288</sup> Hughes, “The Welsh Language in Technology and Science,” 422.

short 16-page pamphlet. First published in New York newspaper the *Sun* in 1835, it was a series of six satire articles that claimed John Herschel had observed walking creatures on the moon. Ifano Jones, Cardiff's Welsh librarian, showed the translation of the well-known hoax to visitors after it was published in Welsh at Llanrwst in 1837.<sup>289</sup> Jones framed Herschel's search (and supposed discovery) of extraterrestrial life as a religious pursuit. Herschel's observatory in South Africa was portrayed as a sort of monastery, where the astronomer piously observed every night.<sup>290</sup> The translation of the *Moon Hoax* demonstrated that audiences in Wales had access to the latest astronomical publications, and that they were up-to-date with the newest controversies. Translators had a demand for Welsh astronomical works that were more accessible to broader, poorer audiences by printing material in cheap pamphlets.



Figure 9.  
Lithograph of a “ruby amphitheater” described in the *Sun* in 1835.  
Reproduced from Michael J. Crowe, *The Extraterrestrial Life Debate: Antiquity to 1915* (Notre Dame: University of Notre Dame Press, 2008), 273.

<sup>289</sup> English translation of the Welsh title: *The Story of the Moon, presenting the Oddities Discovered by Sir John Herschel with the Assistance of a Telescope*. Richard Adams Locke, *Hanes Y Lleuad yn gosod allan y rhyfeddodau a ddarganfyddwyd gan Syr John Herschel, trwy gynnorthwy gwydr-ddrych, yr hwn a bwysa saith dunell, yn mwyhau y gwrthrych i 42,000 o weithiau, a'i galluogai i ganfod yn y lleuad, greigiau, coed, blodau, gwastadtiroedd* (Llanrwst: John Jones, 1837).

<sup>290</sup> Locke, *Hanes Y Lleuad*, 15.

The desire for scientific content is further evidenced by the popularity of periodicals with such material. Welsh-language periodicals that featured scientific articles were some of the most prominent publications during the century. *Seren Gomer*, originally a weekly newspaper established by Reverend Joseph Harris of Swansea in 1814, featured astronomical articles in nearly every issue.<sup>291</sup> Ralph Griffiths argues that Harris played a major role in making it a “very successful and influential Welsh periodical.”<sup>292</sup> By 1833, *Seren Gomer* had reached sixteen volumes and experienced “very extensive circulation.” The *Cambrian Quarterly Magazine and Celtic Repertory* noted the periodical as “one of the most popular periodicals in the Welsh language.” Monthly issues exceeded 2000 copies.<sup>293</sup>

By the mid-century, other periodicals followed and included more scientific topics. The Welsh-language women’s periodical, *Y Frythones*, often featured articles discussing topics in astronomy.<sup>294</sup> The monthly periodical included biographies of prominent women in poetry and music, but also featured biographies of scientific women. One example is an article published on Mary Somerville in 1879 that emphasized her “very intense volumes” on astronomy. One of her works, *The Connection of the Physical Sciences*, was noted for its use as a “class-book” in “our main schools.”<sup>295</sup> The periodical *Y Wawr*, first published in 1850, was possibly the first Welsh periodical to be wholly devoted to science. This “Literary and Arts Magazine” contained a large

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<sup>291</sup> After 1818 *Seren Gomer* converted to a periodical.

<sup>292</sup> Griffiths, *The City of Swansea*, 15.

<sup>293</sup> “Literary Notices,” *Cambrian Quarterly Magazine and Celtic Repertory* 5, no. 20 (1833): 610, <https://journals.library.wales/view/2070008/2119765/137>.

<sup>294</sup> “Falen o Hen Lyfr,” *Y Frythones* 7, no. 7 (1885): 218-220, <https://journals.library.wales/view/2649281/2650399/23>.

<sup>295</sup> Original text: “Ysgrifennodd a chyhoeddodd luaws o gyfrolau dyfnddysg iawn ar seryddiaeth, daearyddiaeth, a’r gwahanol wyddorau, un o ba rai o leiaf (*The Connection of the Physical Sciences*) a ddaeth yn class-book y nein prif ysgolion.” “Mary Somerville,” *Y Frythones* 1, no. 12 (1879): 359, <https://journals.library.wales/view/2649281/2985009/4>.

quantity of articles concerning astronomy and physics.<sup>296</sup> Periodicals promoted the consumption of scientific knowledge and their popularity reflected Welsh desires for more scientific material.

Welsh-language periodicals discussed current astronomical phenomena in an attempt to introduce readers to astronomy. For example, the general interest magazine, *Y Seren Ogleddol*, reported on a solar eclipse that occurred in Wales in May 1836 that was an “unusual event.” The magazine followed the report with a description of the eclipse couched in natural theological terms, alluding to religious affiliations with astronomical events:

In some places in the principality, it was said that crows went to their woods, and birds went to their nests, and bats made their appearances; hens looked for their roosts. Nature had become saddened, as though struck by fright and surprise; the air was cold and dark black, as though some dreadful outpouring was about to come to the earth from something unusual; and after the veil had been moved a little off the face of the king of the day, here was nature as though rising from the dead to life, and the bats escaping to their holes, and the little birds singing sweet praise to their Creator, and everything showing cheerful and pleasant as before. “See here parts of his paths, but how little is the thing that we hear about him!”<sup>297</sup>

A periodical’s religious connections were crucial for its success because of alternative religious networks of distribution. The majority of the educational scientific articles first appeared in religious periodicals. Religious magazines were advertised and sold by ministers, and new publications were frequently announced at week-night services.<sup>298</sup> Discussing religion’s relationship with astronomy enabled periodicals to reach greater audiences and to distribute articles through chapel networks and provide astronomical news to a growing base of readers.

A major issue facing publishers was how to discuss complex scientific topics in Welsh in formats larger than short periodical articles. The editor of *Y Brud a Sylwydd*, Joseph Davies,

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<sup>296</sup> “Tolo Wyn Williams, ‘Nodiadau o’r Colegau’, *Gwyddonydd*, IV (1966), 173.” Cited in Hughes, “The Welsh Language in Technology and Science,” 417.

<sup>297</sup> *Y Seren Ogleddol*, June 1836, 183. Cited in Bryn Jones, “Historical Eclipses in Wales,” accessed February 14, 2018, <http://www.jonesbryn.plus.com/wastronhist/eclipseshist.html>.

<sup>298</sup> Geoffrey Cantor et. al, *Science in the Nineteenth-Century Periodical* (Cambridge: Cambridge University Press, 2004), 72-73.

revealed that, “[w]e have not had the pleasure of reading hardly one book ... on any scientific or artistic subject in which the Welsh has not been horribly mangled, not to mention the writer’s ignorance of the subject with which he was dealing.”<sup>299</sup> Periodicals were valuable publications because they introduced broad audiences to astronomical topics. However, interested individuals struggled to find further reading material. Davies’ worries were finally allayed in the mid-century, as increasing numbers of translated works appeared, while by 1850 the first purely astronomy book was published for a Welsh audience.

### Welsh-Language Books

The great obstacle that Welsh people encountered in learning astronomy was a lack of large books in the Welsh language that dealt with the science in a substantial fashion. Until Eleazar Roberts’ translations of Thomas Dick in two volumes in 1842 and 1850, there was in fact virtually no basic astronomically-related books in Welsh. However, there were a few exceptions. Robert Roberts was the foremost Welsh-language publisher during the first three decades of the nineteenth century, publishing the *Holyhead Almanac* and other large books that covered various science in conjunction with religion and poetry. He released two large volumes that covered astronomy. The first, *Daearyddiaeth (Geography)* was published in 1816 and featured a chapter on astronomy.<sup>300</sup> This chapter was aimed at serious practitioners of astronomy. Throughout its 480 pages, Roberts described several aspects of planetary astronomy, but also included poetry that projected aesthetic qualities onto the planets to evoke sublime feelings for

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<sup>299</sup> Joseph Davies, *Y Brud a Sylwydd* 1, (1828): 121-122. Cited in Hughes, “The Welsh Language in Technology and Science,” 429.

<sup>300</sup> The chapter was titled “Arweiniad i Wybodaeth o Seryddiaeth” (“A Guide to a Knowledge of Astronomy”).

the reader.<sup>301</sup> Robert listed 600 subscribers to his work, with many ordering multiple copies.<sup>302</sup>

The knowledge of Roberts' endeavours in newspapers, together with his subscriber list, suggests that the astronomer was known throughout Wales as well as in parts of England.<sup>303</sup>

Roberts' other major published work, *Seryddiaeth*, displays how sources portrayed astronomy differently depending on their target audience.<sup>304</sup> *Seryddiaeth* was geared towards a layman audience with no prior knowledge of astronomy, which differed from *Daearyddiaeth*'s audience of serious practicing astronomers. In reality, *Seryddiaeth* contained no factual scientific material, but served as a treatise on astrology. However, in both works Roberts uses the term "seryddiaeth" (astronomy). This term was used correctly in *Daearyddiaeth* to refer to astronomical science. Yet in *Seryddiaeth* it is used to refer to mysticism and astrological practices. Roberts' two works show how astronomy was fused into a natural theological understanding of nature. Roberts stressed that "by astronomy and geography alone can we gain knowledge of the greatness of God."<sup>305</sup> Natural theological arguments permeated all of his work.

Another Welshman, Greenwich observer John William Thomas, published one of the first works dedicated solely to astronomy in the Welsh language. His publication, *Darlith ar Seryddiaeth (Lecture on Astronomy)* was based on a series of lectures given to the Cymrodorion Society in London, but it was published out of Caernarfon, north Wales. The text was written in

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<sup>301</sup> Some topics included the Solar System, predictions of eclipses, seasons, measuring the size of earth, light, atmosphere, meteorological phenomena, comets, and, most importantly, a dictionary of astronomical terms. Roberts, *Daearyddiaeth*.

<sup>302</sup> See, for example, R. Sanderson, from Bala - 12 copies, or Peter Evans, of Trefiw - 6 copies. Many subscribers were from Holyhead, north Wales (where Roberts operated), but there were also others from Liverpool. Roberts, *Daearyddiaeth*, ix-xv.

<sup>303</sup> Roberts also edited numerous magazines and journals. Some examples include *Yr Eurgrawn Wesleyaidd* and *Eurgrawn Mon*. One periodical notes *Yr Eurgrawn Wesleyaidd*, first published in 1808, as "the oldest Welsh periodical in the Principality." Though not specifically scientific, they demonstrated Roberts' authority in the Welsh publishing business during the first three decades of the century. "Literary Notices," 610.

<sup>304</sup> The title in English: *Astronomy, or a book of knowledge showing the rule of the planets on human beings*.

<sup>305</sup> "Trwy seryddiaeth a daearyddiaeth yn unig y cawn un wybodaeth am fawredd Duw. Idris o Gydi, 'Seryddiaeth a Daearyddiaeth', 121." Cited in Hughes, "The Welsh Language in Technology and Science," 419.



1835, but not published until after his death in 1840.<sup>306</sup> It featured descriptions of each planet, drawings done by Thomas himself, and tables on when one could best observe different astronomical events including eclipses, transits, and sun spots.<sup>307</sup> Thomas' published lectures were the first publication in a new period of Welsh-language astronomical publishing that saw increased numbers of material for entirely Welsh audiences.

The 1840s began a significant period in the expansion and growth of Welsh publications on astronomy. The works of the Scottish astronomer and professor of theology Thomas Chalmers were some of the first that were translated into Welsh. The translation of *Astronomy and the Bible* demonstrated how translators overcame terminological difficulties. Its translator, Griffith Parry, often defined Welsh scientific terms with English footnotes, such as “Gwyddoriaeth - science in general, as ‘the discoveries of science’. Gwyddoreg, gwyddawr - any particular science, as, ‘the science of Astronomy’.”<sup>308</sup> Eleazar Roberts included appendixes in his works that provided an in-depth glossary of the astronomical definitions.<sup>309</sup> The use of glossaries demonstrated how Welsh authors overcame terminological problems. They became a key tool that translators utilized to adapt the Welsh language and enable scientific learning.

Eleazar Roberts' translations were some of the first astronomical works available to Welsh audiences in addition to his articles in different journals and periodicals. In *Ymwelydd Misol*, Roberts published “Ymgom am y Ser” (A Conversation about the Stars). In *Y*

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<sup>306</sup> The pamphlet looked forward to the solar eclipse of 15 May that occurred in 1835, but Thomas was described as “the late famous J.W. Thomas (Arfonwyson)” in the publication which suggests that his lectures were not released until after his death. Thomas, *Darlith ar Seryddiaeth: a draddodwyd yn Nghymdeithas Cymreigyddion Caerludd* (Caernarfon: H. Humphreys, ca. 1840), 15-16.

<sup>307</sup> Thomas, 34.

<sup>308</sup> Griffith Parry, *Seryddiaeth a'r Beibl: neu, Gyfres o ddarlithiau ar grefydd ddatguddiedig yn ei perthynas a seryddiaeth ddiweddar* (Wrexham: Hughes a'i Fab, 1871), 20.

<sup>309</sup> Eleazar Roberts, *Y Dosparth Heulawg* (London: Religious Tract Society, 1850). Cited in Bryn Jones, “A History of Astronomy in Wales.”

*Traethodydd* he published “The Telescope and its Discoveries.”<sup>310</sup> Eleazar Roberts was one of the most significant figures for Welsh astronomical publishing during the nineteenth century. His publications enabled broad Welsh audiences access to astronomical knowledge. Working out of Liverpool, Roberts stayed well-connected to Welsh contacts while he also operating his own observatory in Wirral, north Wales.<sup>311</sup> Writing after his death, J. Silas Evans emphasized Roberts’ significance in Wales: “It is a pity that space does not permit us to give more details about such a dear and pure character, a genius so brilliant, and a life so full of good deeds. Indeed, a star of the first magnitude sent from the heavens and from the Welsh church.”<sup>312</sup> Roberts’ reputation as Wales’ premier translator lasted from the 1840s until his death in 1912. Evans further noted on Eleazar Roberts as the first astronomer to publish in Welsh:

The first to publish an astronomical treatise in Welsh was Eleazar Roberts, and though that was sixty years ago, it was delightful to think the veteran was still alive and vigorous. It was the reading of this treatise that helped to make an astronomer of old John Jones, the Bangor working man, of whom Mr. Mee gave an interesting account. John Jones was a remarkable man, and with early advantages would have shone as a star of the first magnitude in the firmament of learning.<sup>313</sup>

The relationship between Mee, Roberts, and Jones demonstrated growing astronomical linkages in Wales. Translators worked and corresponded with other astronomers from various social levels, as they worked together to bring more astronomical knowledge to Welsh audiences.

Despite the increase in Welsh-language periodical publishing, as well as Eleazar Roberts’ first translations, the doubts over book publications remained. One contributor to *Y Diwygiwr* in 1846 wrote, “if we search the libraries for writings on nature and the attributes of the air, the power and effects of the elements, the size and movement of the planets... they have not yet

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<sup>310</sup> Evans, *Seryddiaeth a Seryddwr*, 275.

<sup>311</sup> Evans, 276.

<sup>312</sup> Evans, trans. Rhys Morris, *Seryddiaeth a Seryddwr*, 276. Cited in Bryn Jones, “History of Astronomy in Wales.”

<sup>313</sup> Evans, 275-276. Cited in Bryn Jones, “A History of Astronomy in Wales.”

come through the Welsh printing press.”<sup>314</sup> The number of Welsh publications slowly increased, but the breadth of their distribution was still doubted by prominent men of science. David Thomas of Llanelli noted, for example, “[w]e regret that the Welsh printing press has produced hardly any scientific works, except for the Geography of J.T. Jones, the Astronomy of Simon Lloyd, and the Christian Philosopher, which is a translation of the work of Dr. Dick.”<sup>315</sup> By the time of Thomas’ comments, there were several Welsh publications on astronomy, including Eleazar Roberts’ translations, John William Thomas’ published lectures, Robert Roberts’ manuscripts, and numerous periodical and journal publications. More Welsh authors were emerging, but the quantity of publications being released remained in doubt.

However, Welsh publishing experienced a period of prosperity during the second half of the nineteenth century that saw new books published for large groups of Welsh readers. 1850 marked a turning point in Welsh-language publishing when Edward Mills published the first astronomical text for a solely Welsh-language audience. Mills’ *Y Darluniadur Anianyddol* (*The Illustrated Physics*) totaled 256 pages and included 80 woodcut illustrations made by Mills and his son. The book was released initially as a series of 12 issues over the course of the year, priced at three pence each. In his work, Mills detailed the principles of astronomy, such as the basics of the constellations and planets, as well as how to find these objects with the naked eye.<sup>316</sup> A possible motivation for releasing his book piecemeal was so that his readers could better afford the work. Based on the popularity of his lectures, Mills was incredibly successful. It is also important to note the Mills family’s position within Wales as a well-known, wealthy dynasty.<sup>317</sup>

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<sup>314</sup> R. Owen, “Sefyllfa Bresennol yr Iaith Gymraeg,” *Y Diwygiwr* 11, no. 129 (1846): 113-115. Cited in Hughes, 418.

<sup>315</sup> David Thomas, “Traethawd ar yr Argraffwasg,” *Taliesin* 2, (1860): 168-82. Cited in Hughes, 418.

<sup>316</sup> Edward Mills, *Y Darluniadur Anianyddol*, 81-86.

<sup>317</sup> The Mills family eventually settled in Pontypridd where they were very active in musical circles. For more on the Mills family, see Ronald E. Morris, “The Mills Family of Llanidloes: Composers, Printers and Writers,” accessed February 26, 2018, <http://history.powys.org.uk/history/llani/mills1.html>.

Welsh-language publications on astronomy continued into the twentieth century. Caradoc Mills' *Y Bydoedd Uwchben: Llawlyfr ar Seryddiaeth* (*The Heavens Above: A Handbook on Astronomy*), published in 1914, served as a popular book to novice astronomers.<sup>318</sup> Mills was educated at the University College of North Wales, in Bangor; by this period, secondary scientific education was finally available in Wales. Caradoc Mills was also of the same family of Edward Mills.<sup>319</sup> They continued a legacy of multi-generational astronomical families in Wales, joining Robert Roberts' family and the Dillwyns as but a few examples of the pervasiveness of astronomy on all members of Welsh society. Welsh-language publications experienced a very different development from that of English-language material, but by the end of the century both were available to different readers of varying gender, class, and location.

### **English-Language Books**

There was no shortage of English-language material advertised to residents in Wales. As early as the first decade of the nineteenth century, wealthy Welsh residents could purchase the newest astronomy books. One of the first textbooks advertised in nineteenth-century newspapers was written by John Thomas.<sup>320</sup> Especially at private academies, advertisements promoted cheap astronomy textbooks. In terms of education, early nineteenth century advertisements noted useful books to students and scholars who were members of day schools and Sunday schools. One example is John Greig's *An Introduction to the Use of the Globes, for Youth of both Sexes*. An advertisement that promoted the work stated that, "this is a very useful manual for students in

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<sup>318</sup> Caradoc Mills, *Y Bydoedd Uwchben: Llawlyfr ar Seryddiaeth* (Bangor: P. Jones-Roberts, 1914).

<sup>319</sup> Evans, *Seryddiaeth a Seryddwr*, 291.

<sup>320</sup> Astronomy was covered in chapter 4 ("Seryddiaeth") of Thomas' work. John Thomas, *Introduction to all the various branches of useful Learning and Knowledge, in IV parts* (Wrexham: A. Tye, 1815), 356-386.

astronomy; the problems are judiciously selected, and the solutions neat and conspicuous.”<sup>321</sup>

Adhering to both male and female readers reflected the inclusive aspect of astronomy.

Books on astronomy were accessible and often advertised. Dr. Gregory’s *Popular Lectures on Natural Philosophy, Astronomy, and Chemistry* is an early example. It was advertised in the *Cambrian* as early as 1808.<sup>322</sup> Academies had no shortage of options when choosing an astronomy textbook. The multitude of English-language astronomy books only increased by the mid-century.

By the 1830s, academies were using a few different textbooks. In addition to Gregory’s work, other examples included Squire’s *Grammar*, Clarke’s *Wonders of the Heavens*, and Phillips’ *On the Use of the Globes*. Advertisements emphasized the practical educational benefits presented in textbooks as well as “their popular and lucid display of every desirable subject of study, which have led to that surprising advance of knowledge, so characteristic of the present age.”<sup>323</sup> Books mirrored lectures, offering practical education as well as promising sublime entertainment to readers, albeit on an individual level rather than as a public spectacle. Education was valued in Wales for its practical application in everyday life as newspapers promoted its benefits and uses. One advertisement on “Explanatory and Scientific Schools Books” stated that it “earnestly recommend[s] Parents, Teachers, and all who have the care of Youth, to examine them with attention, and to satisfy themselves that their claim to superiority (which has been awarded by a liberal and discerning public) is not exaggerated.”<sup>324</sup>

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<sup>321</sup> “Advertising,” *North Wales Gazette*, June 25, 1812, <http://newspapers.library.wales/view/3872240/3872242/10>.

<sup>322</sup> “Advertising: Superior Elementary Books,” *Cambrian*, December 31, 1808, <http://newspapers.library.wales/view/3321870/3321874/19>.

<sup>323</sup> “Improved Modern Education,” *Cambrian*, July 30, 1836, <http://newspapers.library.wales/view/3328820/3328824/18>.

<sup>324</sup> “Systematic Education,” *Cambrian*, October 9, 1819, <http://newspapers.library.wales/view/3324475/3324476/1>.

Advertisements placed emphasis on educating children. A scientific education was portrayed as better preparing them for life because of its practical uses and spiritual influence. Suggested books were categorized into spelling and reading, grammar, writing and arithmetic, history, geography and astronomy, and religion and morality. Prices were included as well as possible further readings on astronomy from the *Juvenile Encyclopaedia*, totaling seven volumes.<sup>325</sup> The emphasis on teaching astronomy to both children and adults paralleled Sunday school's composition of all ages, where astronomical learning was a lifelong enterprise.

By the last decades of the nineteenth century, English-language astronomical publishing in Wales expanded through the work of members of the Astronomical Society of Wales. In addition to spearheading the formation of the Society and editing the Society's journal, Arthur Mee released popular books on astronomy geared towards novice astronomers and directed readers to relevant astronomical work that beginners could pursue. Mee's goal was to form a "stepping-stone to a practical acquaintance with the scenery of the heavens," and give "in simple terms the results achieved by the latest research in those departments most affected by the amateur." He included poetry throughout his work.<sup>326</sup>

There were numerous Welsh authors publishing popular works on astronomy in English, especially towards the end of the century. For example, Thomas Edward Heath's two books covered both planetary astronomy and the emerging practice of spectroscopy.<sup>327</sup> The new material on spectroscopy suggests that astronomers in Wales did not limit themselves to solely

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<sup>325</sup> "Systematic Education."

<sup>326</sup> See for example in *Observational Astronomy*, where he opens with his own poem on the wonders of observing the heavens with the naked eye. Mee, *Observational Astronomy*, 1.

<sup>327</sup> Thomas Edward Heath, *Our Stellar Universe: A Road-book to the Stars* (London: King, Sell, & Odling Ltd., 1905); Thomas Edward Heath, *Our Stellar Universe: Stereoscopic Star Charts and Spectroscopic Key Maps* (London: King, Sell, & Odling Ltd., 1905).

planetary and meridian astronomy; astronomers had access to the newest equipment, such as spectroscopes that were first advertised by the Astronomical Society of Wales.

Books covered many potentially controversial topics in astronomy, including the extraterrestrial life debate and the relationship between astronomy and religion. Discussions on the possibility of extraterrestrial life regularly focused on the moon and Mars. In Mee's *Observational Astronomy*, he detailed debates surrounding the moon that had occurred over the course of the century. Mee used this debate to attract more observers to study the moon:

It cannot be denied that one great inducement to the study of the Moon has been to detect signs of life or of change upon its surface. In early telescopic days the fact of the Moon being inhabited was confidently affirmed, and even within the present century it was believed that activity, at all events volcanic, prevailed upon an extensive scale... If there be life on the Moon it must be vastly different from anything to which we are accustomed upon earth.<sup>328</sup>

Mars received significant attention from Welsh authors and astronomers, especially in the later century during the height of the Mars canals debate.<sup>329</sup> Mee concluded that the canals were an objective truth, but that the existence of life was left to “telescopists of the future.”<sup>330</sup> As evidence for the canals, Mee brought Welsh readers’ attention to the work of a number of astronomers in Europe and America. He noted Schiaparelli’s first sight of the canals and the developments since then, “[t]he existence of these lines [canals] was long disputed, but the corroboration of Terby, Perrotin, and others on the Continent, the Mount Hamilton observers (to some extent) in America, and Stanley Williams in England, leaves no doubt as to their reality.”<sup>331</sup> Mee gave his own evidence on the existence of water when he detailed that during his

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<sup>328</sup> Mee, *Observational Astronomy*, 36.

<sup>329</sup> In the late nineteenth and early twentieth centuries, the majority of astronomers debated over the existence of a system of “canals” on Mars. The Canals were first observed by Italian astronomer Giovanni Schiaparelli during the opposition in 1877. Schiaparelli called the lines he saw “canali,” which was translated as “canals.” For more, see Crowe, “The Controversy over the Canals of Mars,” in *The Extraterrestrial Life Debate*, 470-517.

<sup>330</sup> Mee, *Observational Astronomy*, 53.

<sup>331</sup> Mee, 53.

own viewings of the planets “the impression of sea and land and polar snow was overwhelming.”<sup>332</sup> Welsh authors brought the latest debates in astronomy to a wide audience of readers in Wales.

Readers were informed on other contemporary debates in astronomy as well. The search for the planet Vulcan, one of the most controversial topics in nineteenth-century astronomy, was well-documented.<sup>333</sup> Vulcan was the product of Mercury’s confusing motions. In 1859, French astronomer Urbain Le Verrier argued for the likelihood of a planet rotating between Mercury and the Sun, and that this new planet, Vulcan, accounted for Mercury’s odd orbit.<sup>334</sup> Mee informed Welsh readers on the hunt for the ghost planet in his work, but with much less excitement than he expressed towards the canals. Mee commented that “the existence of the alleged inter-Mercurial planet - Vulcan - grows increasingly improbable yearly.”<sup>335</sup> Despite the growing doubts over the existence of Vulcan, the discussions that occurred highlighted the linkage between Wales and the wider astronomical world, where Mee was a crucial figure who brought the latest astronomical news to a Welsh readership.

Mee’s work also instructed readers on where to find the different local societies in Wales, the number of available “illustrated manuals,” and the numerous periodical publications on astronomy. Emphasis was placed too on attracting potential female observers to astronomy. Mee noted, “the exquisitely delicate perceptions of the sex fit them, in many ways, even more than men, for telescopic study,” where Mee made an explicit note to gain more “lady observers.”<sup>336</sup> In his attempt to educate and attract a female audience, Mee discussed the work of previous women

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<sup>332</sup> Mee, 52.

<sup>333</sup> For more on the search for Vulcan, see Richard Baum and William Sheehan, *In Search of Planet Vulcan: The Ghost in Newton’s Clockwork Universe* (New York: Plenum Press, 1997).

<sup>334</sup> Baum and Sheehan, *In Search of Planet Vulcan*, 1-4.

<sup>335</sup> Mee, *Observational Astronomy*, 57.

<sup>336</sup> Mee, 26.



in astronomy. In his examination of William Herschel's discovery of Uranus, Mee instead focused on the efforts and achievements of his sister, Caroline Herschel.<sup>337</sup>

Popular books geared towards beginner astronomers often laid out the types of work that new astronomers should pursue. Practical uses of astronomy were paramount, where "by a tacit understanding between the professional and the amateur astronomers, those observatories are expected to be devoted chiefly towards the following objects:" including sunspots, the moon, eclipses, planets, comets, small stars, double stars, binary stars, variable stars, and nebulae. Most books contained a catalogue and map, where the main task given to aspiring astronomers was to fix errors from previous catalogues and editions.<sup>338</sup> Other publications included discussions on recent research including the endeavours of astronomers in Britain and Europe, and observations being made at Greenwich.<sup>339</sup> An individual interested in learning astronomy had, by the late century, more available sources of learning than ever before.

Journals included advertisements for cheap telescopes, and informed readers on what they should be observing. Wales does not seem to have had any prominent telescope manufacturers. Instead, new astronomers in Wales had to travel to England to obtain a telescope. Many advertisements offered readers information on where to purchase telescopes, eyepieces, and other astronomical equipment from various shops in London. These advertisements were joined by publications urging more people to purchase telescopes, such as Parry Jenkins' booklet *A Plea for the Reflecting Telescope*.<sup>340</sup> Likewise, the *Cambrian Natural Observer* featured numerous advertisements of the cheapest available telescopes and informed readers on what to

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<sup>337</sup> Mee, 60.

<sup>338</sup> Darby, *The Astronomical Observer*, xxxv.

<sup>339</sup> Parry, *Seryddiaeth a'r Beibl*, 20.

<sup>340</sup> Jenkins' article was published in both Wales and Canada after he relocated to Toronto. Parry G. Jenkins, "A Plea for the Reflecting Telescope," *Journal of the Royal Astronomical Society of Canada* 5 (1911): 59-75. Evans, *Seryddiaeth a Seryddwr*, 285.

observe. Mee stated that “the amateur may also do good service in the cause of astronomy by watching for new or temporary stars, such as that which made its appearance in Auriga, and which was discovered in 1892 by Mr. Anderson, an amateur astronomer.”<sup>341</sup> Popular books explained how to look for and track both new and catalogued stars.

**TELESCOPES**  
SPECIALLY CONSTRUCTED FOR  
**STUDENTS IN ASTRONOMY.**

Our “Student’s Telescope,” with Finder, best quality 3-in. Object Glass, 3 Astronomical Eyepieces. Telescope mounted on Strong Tripod Stand. Case with lock and key. **£14 10s.**



We supply an “Educational” Telescope, 3-in. Object Glass, 3 Eyepieces, Finder and Claw Stand, in Case, **£7 17s. 6d.** Wonderful Value.

This illustration represents our Equatorial Mounting for 3in. Telescopes, with either an Iron Pillar or Wooden Tripod, **£10 10s.** Or with best 3in. Telescope, complete with Eyepieces, **£22 10s.**

**DOLLOND, 35, Ludgate Hill, E.C.**

Figure 10.

Advertisement for a reflecting telescope directed at students learning astronomy.

“Queries,” *Journal of the Astronomical Society of Wales* 1, no. 2 (1895): 18.

## Literary and Scientific Heritage

Despite the number of concerns over Welsh scientific publishing that were voiced by contemporary practitioners of science, many Welsh authors established a tradition of scientific literature through discussions of Welsh druids. Druidic knowledge was depicted as scientific by nineteenth-century Welsh authors. One journal article sensationalized the recovery of the druids’ knowledge of astronomy. The author wrote that “the storms of war, and the ravages of time”

<sup>341</sup> Mee, *Observational Astronomy*, iii.

destroyed “the fruit of Druidical labour,” some knowledge had survived, “but from the flavour of the little that remains, a conjecture may be formed of the peculiar excellency of taste, for which the rest were celebrated.”<sup>342</sup> Authors did not just use antiquarian material for nostalgic remembrance, but rather used these sources to build cultural participation for a new and present Welsh identity.<sup>343</sup> Knowledge of science and astronomy was reportedly well-known, and through reproducing details of the bards, authors aimed to elevate astronomy as a cultural practice equivalent to poetry and singing in the annals of a constructed Welsh cultural heritage.

One periodical discussed the old Welsh names for the planets and constellations. Noting that the names were “thoroughly Cymric, and most unlike those which are used in other countries” suggested that those in Wales possessed an “early and independent acquaintance with the starry heavens on the part of the Cymry.”<sup>344</sup> Bardic knowledge of astronomy was professed by authors as a signifier of Wales’ scientific heritage. One author remarked:

Allusions are made in the works of the Bards to the different arts and science, as to subjects generally studied and familiarly known, and the fragments on astronomy, on natural history, on logic, and cosmography... and referred to by Edward Llwyd and others, in their catalogues of Welsh manuscripts, are decided proofs that literature had made no inconsiderable progress among the Celts.<sup>345</sup>

Nineteenth-century figures perceived their own literature as originating in Druidic traditions and being carried on by current astronomers; they were the new cultural leaders.

Publications emphasized Wales’ astronomical heritage by constructing narratives that connected the practice of astronomy with Welsh traditional myths and legends. The *Cambrian Journal* argued that scientific education was a Welsh tradition, and it featured articles on numerous topics including philology, topography, botany, biography, music, literary history, and

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<sup>342</sup> “History,” *Cambrian Register* 3, (1818): 102. <https://journals.library.wales/view/2867877/2867880/111>.

<sup>343</sup> Lichtenwalner, *Claiming Cambria*, 117.

<sup>344</sup> Elved, “The Traditionary Annals of the Cymry,” 235.

<sup>345</sup> “History,” 103.

poetry. The journal asserted that astronomical knowledge had been highly valued through Wales' history. Astronomy was touted in Welsh antiquarian society as one of "the three pillars of knowledge with which the Gwyddoniaid were acquainted, and which they bore in memory from the beginning." Their ancestors, "the Cymry," had "a knowledge of the course of the stars, their names and kinds, and the order of the times."<sup>346</sup> Contemporary astronomers were perceived as the heirs to Welsh astronomical knowledge.



Figure 11.  
Late eighteenth-century depiction of a Welsh druid playing the harp. Thomas Pennant, *A Tour in Wales* (London: Henry Hughes, 1778), 144/1.

The connection between science and poetry was well-established and often accentuated in publications. Individuals were often described as being both astronomers and poets. The celebrated author of the Welsh medieval poem *Y Gododin*, Anewrin, was described as "a complete scholar, as well as an eminent poet."<sup>347</sup> Wales' ancestral leaders were portrayed as the

<sup>346</sup> The Gwyddoniaid were druids in Britain and cultural leaders in Welsh antiquarian society. Elved, "The Traditionary Annals of the Cymry," 233.

<sup>347</sup> *Y Gododin* was a medieval poem that detailed the men of the Brittonic kingdom of Gododin in battle at Catraeth in the year 600. The Poem has been ascribed to Anewrin and survived in his manuscript, the *Book of Aneirin*. "History," 105.

gatekeepers of scientific knowledge. Periodicals used these narratives in an attempt to encourage scientific learning among the Welsh public. Cultural notions were used to represent astronomy as an ancient, traditional practice rather than a new, modern scientific discipline.

Old bardic writings were depicted as antiquarian astronomical treatises, and the connection between the Welsh language and astronomy was used to create a scientific heritage. Extracts from the *Traditions of the Bards* were noted for displaying the “knowledge which our British forefathers possessed respecting the heavenly bodies.”<sup>348</sup> The word “astronomer” in Welsh was noted as a compound of *ser* (stars) and *honydd* (one who points out).<sup>349</sup> Additional writing argued that much scientific terminology actually originated from bards, and that the current terminology was “of Celtic derivation.”<sup>350</sup> One example is the name Luna, for the moon, as being a derivative of the old Welsh word *llun*.<sup>351</sup> Other authors argued that astronomy formed the foundation for the entire Welsh language: “[t]hat they [the Welsh] paid attention at an early period to the science of astronomy, which they called *seryddiaeth*, is indicated by the very structure of their language.”<sup>352</sup> The lack of written scientific material did not deter nineteenth-century practitioners of science; instead, the astronomical tradition was portrayed as being orally passed down. The author continued, “one of the oldest words which has, and still is, used to denote *time*, is *amser* (am-ser), which literally signifies the revolution of the stars. They regulated their religious festivals by the entrance of the sun into the solstitial and equinoctial points, and by the quarterly phases of the moon.”<sup>353</sup> The astronomical heritage was further

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<sup>348</sup> Elved, “The Traditionary Annals of the Cymry,” 234.

<sup>349</sup> Elved, 236.

<sup>350</sup> “History,” 103.

<sup>351</sup> Elved, “The Traditionary Annals of the Cymry,” 233.

<sup>352</sup> Elved, 233.

<sup>353</sup> Elved, 233.

enforced in reports of Old Welsh cromlechs (ancient megalithic burial chambers) being built to astronomical plans.<sup>354</sup>

Literature periodicals often made allusions to astronomy and the link between science and culture. In its 1818 issue, the *Cambrian Register* linked Welsh cultural heroes to astronomy. The periodical, edited by William Owen Pughe, published articles on Welsh antiquities, history, and literature. Old Celtic writings were noted for their astronomical references:

In some fragments of the writings of the Celts the proficiency made in the earlier ages, in each particular science, is not only specified, but the persons the most celebrated for their profession of them, and the most remarkable for their skill in them, are recorded with apparent correctness and precision.<sup>355</sup>

Writers used astronomy in its practical applications to argue for the prevalence of Welsh culture. One author contested: “That the application of astronomical acquisitions to the purposes of navigation was not unknown to the Celts, seems corroborated by several extraordinary traditions.” Old Celtic heroes were detailed as holders of immense astronomical knowledge. One example was the story of Madog, the son of an antiquarian prince of North Wales. He was revered for using his knowledge of the stars to steer ten ships across the Atlantic as “the first European discoverer of the American continent.”<sup>356</sup> Astronomy was used as a tool to build cultural myths and legends, and create a scientific tradition to be continued by contemporary astronomers, who were viewed as equally iconic as their Welsh ancestors.

Astronomical knowledge was reproduced in Celtic writing, and further relayed through periodicals in the nineteenth century. One example is Gwdion, an early Celtic astronomer. He was “celebrated for his knowledge of the stars, and is described as one of the three sublime

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<sup>354</sup> A Cromlech was a sort of tomb made using large flat stones laid against upright ones. Evans, *Seryddiaeth a Seryddwr*, 262.

<sup>355</sup> “History,” 89. Lichtenwalner asserts that the work of editors like Pughe was an act of resistance to attempts to dilute the Welsh identity and replace it with a more general British one. Lichtenwalner, *Claiming Cambria*, 125-126.

<sup>356</sup> “History,” 90.

astronomers of Britain. The name given him... seems to imply that he converted his skill in astronomy to the purposes of navigation.”<sup>357</sup> Early periodicals signified the importance of having practical astronomical knowledge. This heritage was historicized as being a part of Wales’ cultural heritage. Gwdion was “a favourite epithet among the bards for the Galaxy, or the milky way;” the Galaxy was even named after the astronomer.<sup>358</sup> A tradition of practical scientific practice in Wales aided new publications that encouraged scientific education across Wales.

The “three of our most eminent astronomers” were noted in different periodicals, and reported from their records in the Triads, a group of medieval manuscripts that detailed Welsh folklore, mythology, and legends. One periodical described the three individuals as iconic Welsh heroes. One of these “sublime astronomers of Britain” was Idris Gawr. He lived “long previous to the era of history,” and represented the north Wales mountain range of Snowdonia. Cadair Idris, one of the highest mountains in Snowdonia, was named after the astronomer, and literally translates as “seat of Idris.” The mountain was noted as “the fabulous scene of many a romantic tale of the exploits of the father of the astronomical science; as it is of the professional contests of the bards, who seem for many generations to have considered it as their Parnassus.”<sup>359</sup> Other historic authors suggested that Cadair Idris was also the site of the astronomer’s observatory.<sup>360</sup>

Last, Gwyn, the son of Nudd, was celebrated as an astronomer, warrior, and “King of the Fairies.”<sup>361</sup> Gwydion, Idris Gawr, and Gwyn formed the group of “the three blessed astronomers of the Isle of Britain,” where “so great was their knowledge of the stars, and of their nature and situation, that they could foretell whatever might be desired to be known, to the day of doom.”<sup>362</sup>

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<sup>357</sup> “History,” 90.

<sup>358</sup> “History,” 90.

<sup>359</sup> “History,” 89-90.

<sup>360</sup> Elved, “The Traditionary Annals of the Cymry,” 235.

<sup>361</sup> Elved, 236.

<sup>362</sup> Elved, 235.

Welsh writers thereby constructed cultural myths by portraying Welsh icons as astronomical authorities. Narratives constructed both an astronomical and astrological heritage in Wales that was continued by nineteenth-century writers, publishers, and lecturers.

Contemporary Welsh astronomers were held in similar esteem by popular science authors. The first recorded astronomical activity in Wales was reported by Mee. Sir William Lower, working out of Carmarthen in 1610, reportedly received a telescope and recorded lunar observations.<sup>363</sup> Attention was also paid to Thomas William Webb, author of *Celestial Objects for Common Telescopes*. Mee described the astronomer as having “pleasant associations,” and that he worked out of Hardwick on the Welsh border. Mee described Webb’s Welsh connections and that he was valued as “a devoted, untiring, whole-hearted servant of the Church.”<sup>364</sup> The religious connection was important to the general public in Wales. The religious role that astronomers played was crucial to their status as cultural leaders and astronomy as the most desired scientific practice. Webb also delivered lectures to local societies, as well as to female audiences, such as the Ladies’ College which “became an event of annual importance, eagerly looked forward to.”<sup>365</sup> Contemporary astronomical figures were portrayed as the ancestors of Welsh mythological astronomers. Lecturers and astronomers were the new holders and distributors of sacred scientific knowledge that was used to benefit all of Wales.

## Conclusions

The main methods of presenting astronomical material were through books, pamphlets, articles, journals, lectures, and eisteddfodau. Roberts’ role as publisher, editor, teacher, and

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<sup>363</sup> Mee, *Observational Astronomy*, 36.

<sup>364</sup> Mee, 75.

<sup>365</sup> Mee, 76.



lecturer embodied the complete scientific educator in Wales during the early century. That his actions were often reported in both journals and newspapers demonstrated his perceived authority throughout Wales, and the general Welsh approval of astronomical publications.<sup>366</sup> Hughes argues that scientific material did not make much of an impression on Welsh audiences, however, Welsh audiences consumed and reproduced this knowledge differently, and their patterns of consumption must be analyzed in a broader framework that legitimizes more unconventional forms of scientific discourse, such as the *eisteddfod* and the Sunday school, while the periodical press must be considered as a legitimate form of scientific discourse. Authors in Wales sought to spread scientific knowledge to all levels of Welsh society in order to establish astronomy as a subject in everyday life.

Publications in Wales stressed that astronomy was a cultural tradition that was religious, communal, and educational. Periodicals aimed to disseminate scientific knowledge in Welsh and promote the discussion of science across Wales. The relationship between science and religion served as a key element of publications' content. New material was read by a growing literate Welsh audience that sought to consume astronomical knowledge for both personal and social benefits. Welsh understandings of astronomy were shaped by these publications that forwarded notions of religious devotion and practical education that solidified astronomy's position as a significant element of a new Welsh identity and a distinct cultural heritage.

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<sup>366</sup> See, for example, "Seryddiaeth - Adroddiad am Ddwy Ddarlith gan Seryddwr Môn," *Y Gwilydydd* 8, (1831): 256; "Amrywiaethau," *Seren Gomer* 8, no. 173 (1830): 64. Cited in Hughes, "The Welsh Language in Technology and Science," 420.

## Conclusion

By the 1890s, authors and astronomers reflected on the progression of new scientific material over the nineteenth century. Upon observing the newest astronomical publications, Arthur Mee declared that: “The amateur to-day is placed in a vastly different position from his predecessor of 50 or even 20 years ago. Bright, pleasantly written, charmingly illustrated manuals abound; the periodical press is constantly dealing with astronomy; and there are societies established for his especial behoof.”<sup>367</sup> Mee’s comments reflected a century’s worth of astronomical developments in Wales. Lecturers and Sunday schools introduced diverse audiences to the wonders of astronomy. With the aid of orreries and the language of the sublime, astronomy became associated with religious devotion and a distinctly Welsh romantic tradition. Education, religion, and cultural expression were displayed in many forms through lectures, periodicals, books, journals, and even through astronomers’ own telescopes and observatories.

Astronomy functioned in a transitioning Welsh cultural milieu. Science was placed in context to the histories of the bards and druids, as publishers adhered to a romantic spirit that solidified over the course of the century with the emergence of a new Welsh identity. Astronomers and their audiences produced and consumed scientific knowledge in new ways. New spaces were transformed into scientific centres that enabled more intensive forms of education and promoted scientific discussions. The emergence of the scientific marketplace in the nineteenth century was centred in large urban cities including London, Dublin, and Edinburgh, but smaller localities in Wales were popular by the mid-century. Swansea became Wales’ scientific metropolis as the most prominent practitioners of science centralized around the Royal Institution of South Wales and the influence of the Dillwyn family.

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<sup>367</sup> Mee, *Observational Astronomy*, 24.

The mid-century was a watershed moment for lecturing, publishing, and a growing astronomical community in Wales. The Welsh-language lectures of Robert Roberts and Edward Mills captivated audiences. Analyzing audience and reader reactions to the cultural properties of astronomical narratives emphasized the ongoing development and promotion of astronomy in Wales. In the theatre, onlookers were transported to the heavens as cosmic passengers on a sublime voyage. New translations of astronomical material appeared with the work of Eleazar Roberts and Griffith Parry, in addition to increasing numbers of science society journals, new periodicals, and Welsh-language astronomical literature. The establishment of the Astronomical Society of Wales in the last decade of the century was the result of a century's worth of networking, publishing, and educating. Astronomy was used as tool to reconstitute Welsh culture through developing a scientific tradition, reproducing sublime and Romantic experiences, and by pioneering new methods to produce and consume knowledge.

Nineteenth-century science must be analyzed within a broader cultural framework that includes non-scientific and popular sources. Through a bottoms-up approach, the examination of previously unreferenced material, including a bevy of newspaper articles, periodicals, journals, and Welsh-language material, the argument that science was not popular in Wales can be turned on its head. The desire for Welsh-language material and inclusion of astronomy into the workings of everyday life in nineteenth-century Wales showcased the importance that science held in Welsh popular culture. While there were no Herschels or Earls of Rosse in Wales, astronomers nevertheless were valued in their own local communities as prominent figures who embodied a communal, pious, and, above all, a culturally distinct Welsh identity.

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