A History of Popular Astronomy in Australia

in the era of the lantern slide: 1825–1910

Martin Bush

Doctor of Philosophy

Swinburne University of Technology

2017

Abstract

This is the first extended study of popular astronomy in Australia in the nineteenth and early twentieth centuries. There has been considerable interest in the history of popular science in Britain in this period but less study of practices elsewhere. This thesis provides both original research and a comparison.

The periodization 1825–1910 corresponds to the era of the lantern as a major media format, reflecting the importance of visual and material practices. Beyond the general Victorian-era interest in visuality, 'teaching through the eye' had particular relevance to the visual science of astronomy. It is argued that the public knowledge practices of popular astronomy are intimately connected with the technologies of visual and material communication and that the lantern was a particularly high-impact medium.

Research primarily involved analysis of newspapers, magazines, and manuscripts. This included a broad survey of astronomy in popular culture through sources such as travel diaries and weather almanacs, and detailed case-studies, such as the 1880 tour of Australia and New Zealand of the British astronomer Richard Proctor and the use of popular astronomy by freethought lecturers of the 1890s.

A contention of the thesis is that practices of astronomical popularization change on multiple timescales. Scientific discovery can be fast while cultural frameworks change more slowly. Analysing these multiple timescales needs approaches beyond the microhistorical techniques common in recent scholarship. This thesis adopts an analytic framework of *cultural schemata*, which can trace how ideas work through social and material technologies at various timescales.

Five cultural schemata relating to astronomy are described: Australia is a land under the southern stars; astronomy tells of a sky that is a source of power and danger; astronomy gives insight into religion; astronomy is an exemplary science; and astronomy speaks to the human condition through the possibilities of life elsewhere. The astronomical sublime is considered as a combination of these. All are shown to be persistent cultural resources that both reflected and shaped experience. This unique combination of cultural schemata distinguishes popular astronomy from other forms of popular science and scholars should consider 'popular science' as a hybrid category in a similar way that historians of science have considered 'science'.

The local performance of these practices shaped the identities of colonial Australia in a particular way while simultaneously being tied into a worldwide trade in knowledge and entertainment. Astronomy is a notable factor in sustaining the global imagination of colonial Australians.

Acknowledgements

Doing a cultural history of ideas teaches that all knowledge is created in community. Yet it rings true that undertaking a PhD is a lonely exercise. Many people have bridged that gap for me.

The Swinburne Institute for Social Research was an amazingly productive environment.
I particularly wish to thank fellow candidates and ex-candidates for their friendship and support: Robyn Sampson, Amanda Lawrence, Christina Ting, Jennifer Witheridge, Regina Sirendi, Juliana Lobo De Queiroz and Emily van de Nagel. Staff and researchers of the Institute also welcomed me and guided my research: Scott Ewing, Ramon Lobato, Angela Daly, Karen Hughes, Kerry Ryan, Peter Browne, Lorenzo Verancini, Terry Newton, Aneta Podkalicka, Andrew Dodd, Sean McNelis, Stephen Glackin, Sandy Gifford, Linda Briskman, Brian Costar and Viv Waller. This incredible environment was due to the work of Grace Lee and her team of administrators, including Teresa Calabria, Lourdes Jeyacumar and Maria Han. Administrative staff, library staff and associates elsewhere in Swinburne are too numerous to name. I may not have always understood your systems but I have always appreciated your help in navigating them.

Primary research for this thesis was only possible because of the work of librarians, archivists, collection managers, curators and the digital humanities across Australia and New Zealand. I want to thank especially Lorenzo Iozzi from Museums Victoria and Vanessa Jacobs from the Museum of Applied Arts and Sciences for making your collections available to me. Tanya Hill of the Melbourne Planetarium was quick to assist and Gail Davis from State Records New South Wales went to extraordinary efforts for me on a fruitless hunt. The roll-call of always-pestered yet ever-helpful librarians, archivists and collection managers from Museum Victoria, the State Library of Victoria, the National Library of Australia, the Queen Victoria Museum, the Mitchell Library, the Allport Library, the Fryer Library, the Turnbull Library, the National Maritime Museum, the Ballarat Art Gallery, the University of Tasmania Special Collections, the University of Sydney Special Collections, the University of Melbourne Special Collections, Deakin University Special Collections, Victoria University Special Collections, the Public Records Office of Victoria, the State Records of New South Wales, the State Archives of Queensland, the Tasmanian Archives and Heritage Office and the Melbourne Athenaeum would fill a volume in itself. Although I have not met them I would also like to put a shout-out to the facilitators of Trove. It is an incredible asset for Australia without which a study like this would not be possible. Long may it grow.

The subject matter of my study is broad. I could not have managed without the assistance offered by people who know far more than I do. Encountering this generosity of spirit and meeting wonderful people with a passion for knowledge is truly the chiefest delight in doing academic work. Wayne Orchiston, Ruth Barton, Ian Edwards, Zoe Robertson, Tiffany Shellam, Clay Djubal, Allister Hardiman, Mark Butterworth, Peter Love, Colleen Boyle, Richard Smith, James Chase, Emmaline Bexley, Hsiang-Fu Huang, Jan Golinski, John Stenhouse, Simon Nathan, Alexander Hall, Ian Hesketh, Paul Robertson, Jeffrey Smith, Tanya Zoe Robinson and Stephen Szabo: all of you have taught me important things. This thesis reflects that weakly but my gratitude is strong. Of course all errors remain my own unique contribution to this field.

To my mother: you gave me the love of learning. To my father: you taught me the value of work. To the Okes: your support has been invaluable. To Remi, to Aida: you have lifted my every step.

One advantage of doing a thesis a little later in life is to have so many role models amongst my friends. Alex McDermott, Simon Booth, Julie Connolly, Tom Clark, Jess Whyte, Mark Cote, Jen Pybus, Becky Batagol, Cathy Oke, Alison Oke, Anna Clark: you are all inspiring. Help from friends goes well beyond that: assistance and encouragement from Collette O'Neill, Con Tuohy, Simon Kent, Sam Searle, Nick Melchior, Karin Moning, Helen Lawson Williams, Ben Tiefholz and Mark Cornelius was crucial. Did I mention the support the Okes have given me?

I have been fortunate to have several people read my work closely and give invaluable assistance: Bernard Lightman, Richard Gillespie, Fiona Fidler, Rob Oke. At every stage, my panel Liam Burke and Jason Bainbridge encouraged me. My examiners, Charlotte Bigg and Rod Home, engaged with this text in many important ways. Special thanks to panel chair Ellie Rennie for advice throughout. Gratitude to Mike Leach is heartfelt, if just for letting me lift the joke in the first paragraph above.

My supervisors Jock Given, Julian Thomas and Chris Fluke deserve whatever plaudits are due to this thesis. The training you have provided me is far beyond reasonable expectation. Your imprint on my work is everlasting. I can only hope to give credit to that in the future.

My sister Stacey Bush deserves to be acknowledged in every paragraph above. You have been family, friend, mentor, inspiration, reader and subject expert. Thank you.

To my partner Nicole Oke, undying gratitude. To say that this thesis would have been impossible without you is an understatement. To say that I would have few reasons for it without you is not an overstatement. I will never forget the work you have done and the sacrifices you have made to get me to completion. I *am* glad we are past putting each other through this.

Declaration

I declare that this thesis contains neither material by myself that has been accepted for the award of any other degree or diploma nor—to the best of my knowledge—material written by another without due reference. An edited version of Chapter 3 has been published in the *Historical Records of Australian Science.*

Martin Bush

1/11/2017

Contents

List of Tables xii

List of Figures xiii

Prologue 1

1: Studying Popular Astronomy 9

- **1.1 The practice of popular science** 11
- **1.2 The problem of multiple timescales** 16
- **1.3 Lantern slides and materiality** 22
- **1.4 Scope of thesis** 26
- **1.5 Sources** 29

2: A survey of Australian colonial popular astronomy 37

- **2.1 An overview of colonial knowledge practices** 41
- **2.2 Astronomical symbolism in Australia** 47
  - 2.2.1 Southern Cross 48
  - 2.2.2 Antipodes 55
  - 2.2.3 The identity of Europe as Christendom 61
  - 2.2.4 Cultural schema of astronomy: Australia as a land under the southern sky 61
  - 2.2.5 The Southern Cross in Australian flags and arms 71
  - 2.2.6 National Colonial Flag, or Federation Flag 75
  - 2.2.7 Anti-transportation League Flag 79
  - 2.2.8 Eureka Flag 83
  - 2.2.9 Conclusion for the Southern Cross in Australian flags 87
- **2.3 Timekeeping and placemaking: astronomical underpinnings of colonialism** 91
- **2.4 Weather, almanacs and daily associations with the sky** 97
  - 2.4.1 Cultural schema of astronomy: The sky as a site of power... 98
- **2.5 Public astronomical events** 109
  - 2.5.1 Comets 113
  - 2.5.2 Eclipses and transits 127
  - 2.5.3 Conclusion for astronomical events 131

2.6 Astronomy in informal education: Mechanics’ Institutes 132

2.6.1 Astronomy within Mechanics’ Institutes 138

2.6.2 Cultural schema of astronomy: Astronomy as giving insight into religion 149

2.6.3 Cultural schema of astronomy: Astronomy as an exemplary science 150

2.6.4 Conclusion for Mechanics’ Institutes 152

2.7 Astronomy in education: ‘The Use of the Globes’............ 154

2.7.1 Overview of ‘The Use of the Globes’ 154

2.7.2 ‘The Use of the Globes’ in Australia 159

2.8 Conclusion 167

3: Richard Proctor: professional science communication in Australia in 1880 169

3.1 Proctor in Australia............ 172

3.2: Techniques in ‘Life and Death of a World’ 179

3.2.1 History 180

3.2.2 Cultural schema of astronomy: Astronomical sublime 181

3.2.3 Cosmic evolution 183

3.2.4 Literary allusion 187

3.3: Techniques in subsequent lectures 188

3.3.1 Cultural schema of astronomy: The plurality of worlds 188

3.3.2 Contemporary science 190

3.3.3 Striking numbers and familiar metaphors 191

3.3.4 Relationship with audiences 193

3.4: Proctor’s success: Visual communication and controversy. 194

3.5: Proctor's reputation before arriving............ 209

3.6: Proctor and controversy 219

3.6.1 Cometary apocalyptics 219

3.6.2 Religion 224

3.6.3 Henry Parkes 227

3.7: Professor Pepper in Australia 232

3.7.1 Pepper and Astronomy 237

3.7.2 Comparing Memories of Pepper with Proctor 238

3.8: Conclusion 247

4: Visual and material practices in popular astronomy 249

4.1 Astronomy and visual communication 250

4.2 Magic lanterns 259

4.2.1 Overview of lanterns in Australia 259

4.2.2 Visual, material and social practices of magic lanterns........ 271

4.2.3 The photographic lantern slide 283

4.2.4 Memories of lantern culture 287

4.3 Astronomical devices 295

4.4 Astronomy in print.. 311

4.4.1 Newspapers and weeklies 311

4.4.2 Astronomy in books and magazines 313

4.5 Conclusion 335

5: Uses of Popular Astronomy: Secular, labour and professional politics........................... 337

5.1 Popular astronomy in secular–religious disputes 339

5.1.1 The Darwinian context 340

5.1.2 The natural theology context 342

5.2 Secularism in Australia and New Zealand: Joseph Symes and William Whitehouse Collins 346

5.2.1 Joseph Symes.. 347

5.2.2 William Whitehouse Collins.. 348

5.3 Labour movement: popular science and workers' education 359

5.4 Uses by the scientists... 363

5.4.1 Uses of popular science by elite astronomers........................ 363

5.4.2 Uses of popular science by amateur astronomers 371

5.5 Conclusion 381

6: Understanding Australian Popular Astronomy 383

6.1 Astronomical popularization was intimately connected with visual and material practices 385

6.2 Popular astronomy enrolled a distinct set of cultural resources 387

6.3 The multiple timeframes of history 390

6.4 The cultural schemata of popular astronomy in Australia 392

6.5 Ways in which this study could be extended 394

6.6 Conclusion 396

7: Epilogue 399

Bibliography.. 403

Primary Sources 403

References 424

List of Tables

2.1 References to southern stars in shipboard diaries, 1825–50 69

2.2 Astronomical lectures at selected Mechanics' Institutes 1830–1860 147

2.3 Advertisements for 'The Use of the Globes' at schools in 1860, 1870, and 1875–1900 165

3.1 Summary of Richard Proctor's lecture schedule in Australia and New Zealand, 1880 177

4.1 Summary of 38 lantern slides from 'A Popular Lecture on Astronomy' set 279

4.2 Significant astronomical books held in selected Mechanics' Institute libraries, 1854–1864 333

List of Figures

0.1 GOTO Opto-mechanical planetarium projector ... 3
0.2 Astronomical lantern slides in the collections of Museum Victoria ... 5
0.3 Calvin and Hobbes cartoon, 1992 ... 7

1.1 'The Relative Size of Things', 1894 ... 35

2.1 Andrea Corsali's Southern Cross, 1515 ... 53
2.2 The Southern Cross and Ursa Major ... 59
2.3 Shipboard drawings of the southern sky ... 65
2.4 'Watching the Southern Cross', 1879 ... 67
2.5 Coat of Arms for the See of Australia ... 73
2.6 Badge with the Federation Flag, 1899 ... 77
2.7 Australasian League Flag, 1851 ... 81
2.8 Remnants of the Eureka Flag, 1854 ... 85
2.9 'The New Southern Cross', 1916 ... 89
2.10 Rümker chart for telling time from the Southern Cross ... 95
2.11 Francis Abbott's chart showing correspondence of months ... 103
2.12 Extracts from *Clarson, Messina & Co.'s Weather Almanac* ... 105
2.13 'Weather Prophets', 1890 ... 107
2.14 Illustration of a meteor by Becker, 1860 ... 111
2.15 Illustrations of the comet of 1843 ... 123
2.16 Illustration from Flammarion's *Astronomie Populaire*, 1880 ... 125
2.17 Launceston Mechanics' Institute lecture series, 1845 ... 145
2.18 Pair of globes, Benjamin Martin, 12 inch ... 157

3.1 Richard Proctor's Australasian tour 175
3.2 Image from Nasmyth's *The Moon* 199
3.3 Nasmyth's image of a hand and an apple 201
3.4 Photograph of the Moon from the Melbourne Observatory, 1872 .. 203
3.5 Richard Proctor, portrayed on the cover of the *Australian Pictorial Weekly*, 1880 205
3.6 Richard Proctor's map of Mars 207
3.7 Francis Abbott's drawing of Eta Argus, 1868 217
3.8 Professor Pepper and his ghosts 235
3.9 'An Astronomical Study', 1891 243
3.10 'Astronomical Notes', 1880 245

4.1 Wall hangings, Working Men's Educational Union, 1850s 257
4.2 Triunial magic lantern, 1891 265
4.3 Dissolving view slides 267
4.4 Francis Martin Duncan & photomicrographical equipment 269
4.5 Advertisement for Wylie's lecture, 1879 277
4.6 Comic slide, sleeping man eats rat 293
4.7 Keevil mechanical solar system, 1838 305
4.8 Vertical tellurian diagram, 1840 307
4.9 Orrery, William Pearson, 1813 309
4.10 Illustration from *Architecture of the Heavens*, 1842 321
4.11 Cover illustration, *An Easy Guide to Southern Stars*, 1896 323
4.12 Blunt's *Beauty of the Heavens*, 1842, and *The Heavens Illustrated*, 1844 325
4.13 Image from Nasmyth's *The Moon* 331

5.1 Advertisements for astronomical lectures by Collins and Hosking, 1893 357
5.2 'Australasian Society of Mutual Bores', 1888 373
5.3 'Planisphere of the Southern Sky', 1881 375
5.4 Images from newspaper report of Baracchi lecture, 1899 377
5.5 'A New Field for the Telescope', 1890 379

7.1 'Proctor Settled', 1880 401

Prologue

September 1880. Richard Anthony Proctor—the most famous astronomical popularizer of his day—is giving his last series of lectures in Australia. His tour has been successful beyond expectations and astronomical ideas are being widely discussed in newspapers, letters and diaries. Richard Proctor will be remembered in Australia for decades to come.

The reasons for Proctor's success are many. His tour has been skilfully managed by impresario Robert Sparrow Smythe. His use of the most sophisticated visualizations of the time makes an impression. So does controversy. Proctor's presentation of a theme of cosmic evolution, his increasing disputation with church leaders, and his clash with Henry Parkes all draw astronomy into broader cultural, religious and political issues.

September 1980. Carl Sagan's television show *Cosmos* is first screened. This show will be wildly successful, making Sagan the most well-known astronomical popularizer of his generation. *Cosmos*, and Sagan will also be remembered for decades. Sophisticated visualizations and the cultural dimensions of astronomy will be a major part of this success as well.

Thirty years later these memories continue to influence storytelling at the Melbourne Planetarium[1]. The museum of which the planetarium is a part holds a rich heritage of the visual technologies of popular astronomy. The Melbourne Planetarium itself has twenty-first century visualization technology—a full-dome digital projector. In the Planetarium foyer stands an opto-mechanical projector from the HV McKay Planetarium—a mechanical wonder of the 20th century. (See Figure 0.1.) In the Museum's collections lie astronomical lantern slides from Proctor's time, (See Figure 0.2) celestial globes and

[1] Part of the Scienceworks campus of the Melbourne Museum

[2] Secord, *Visions of Science*, 2014, p. 1.

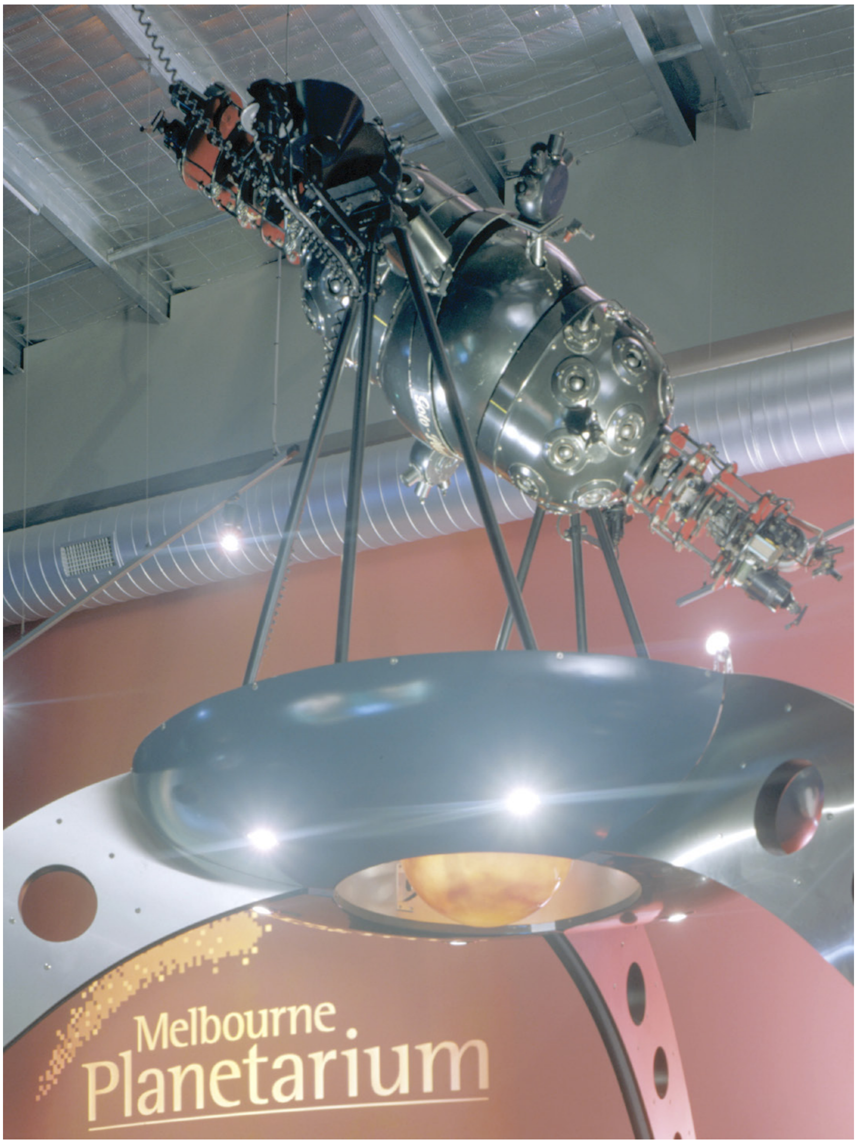
[3] Anderson, *The Cultivation of Whiteness*, 2006.

illustrated magazines. This persistent association of popular astronomy with visualization is notable.

Nor is it just visual techniques that persist. Content also shows surprising continuities. Themes from Proctor's lectures are not out of place on 1980s television or in 2010s planetariums. Possibilities of life on other planets, relationships between science and religion, the destructive possibilities of cometary impacts are all still being talked about. Appeals to the history of astronomy and to the insignificant size of our place in the Universe are ubiquitous.

I am intrigued by the threads running through these vignettes. Technologies have come and gone, and the development of scientific knowledge has been rapid. Why are these echoes of popular astronomy heard across a century and more? Can this help us to understand how popular science makes a difference to people's lives? (See Figure 0.3.)

The music of the spheres calls me. As I leave the Museum, I am resolved to answer these questions.

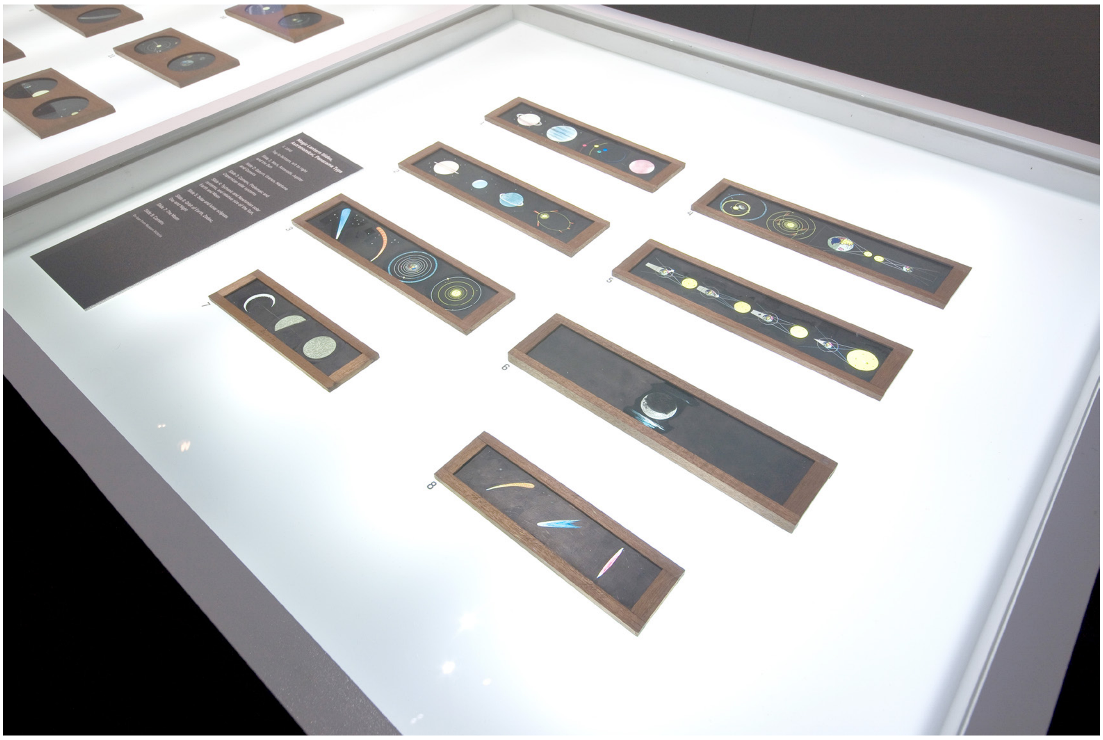


Source: Museum Victoria

Figure 0.1 GOTO Opto-mechanical planetarium projector at the Melbourne Planetarium

The opto-mechanical planetarium projector is a mechanical wonder of the twentieth century, capable of recreating the appearance of the planets in the sky from any given location on Earth, for any date within a particular range. With their complex mechanical gearwork, opto-mechanical planetarium projectors are a development of the orrery tradition. Planetarium projectors also continued the association of astronomy with visualization.

This projector was used at the HV McKay Planetarium in Melbourne from 1956 until 1997.



Source: ACMI

Figure 0.2 **Astronomical lantern slides in the collections of Museum Victoria**

These lantern slides are parts of sets which could be used to give a complete lecture on astronomy. These images are handpainted onto the glass slides, in some cases after the black outlines had been transferred onto the slides by copperplate processes. Lantern slides such as these were in widespread use in Australia in the nineteenth century.

These sets are held by Museum Victoria. Encountering these remarkable objects and appreciating the extent to which they represented an earlier tradition of astronomical visualization was a significant inspiration for my study of popular astronomy.

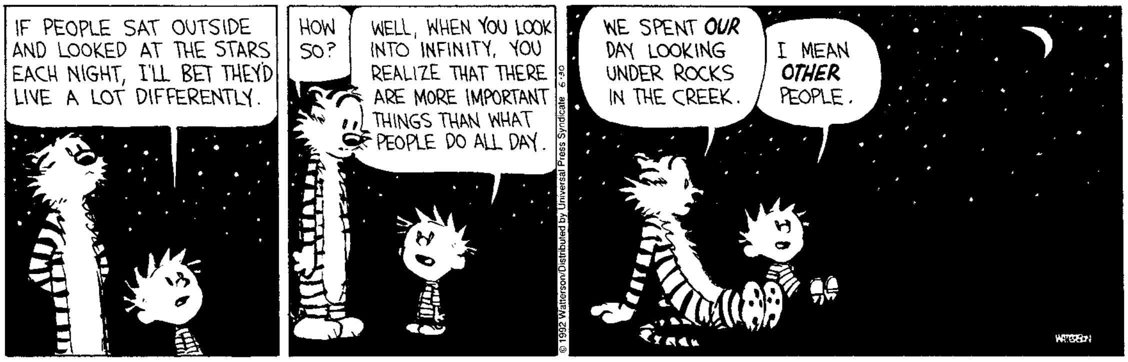


Figure 0.3 Calvin and Hobbes cartoon, 1992

The first panel of this ‘Calvin and Hobbes’ cartoon suggests an important question. Do popular understandings of science allow people to do things differently? If so how?

The cartoon by Bill Watterson was first published on 30 June 1992.

1: Studying Popular Astronomy

This is a thesis about Australian stories of the stars and colonial experiences of the sky, a history of astronomical ideas in public culture. It considers the trade in media representations of the universe and tells of the distribution and spread of knowledge practices in time and space.

Popular science studies describe the interaction of the knowledge of scientific investigators with the lived meanings of popular culture. Previous studies have explicated well that this is mutual. Yet reciprocity is not the same as symmetry. I argue that a consideration of multiple timeframes assists in the understanding of how scientific and popular cultures influence each other.

"When we think of the future, we think of science."[2] Secord, the British social historian of science, suggests that this association arose in the time period of this thesis, 1825–1910. Yet when we think of science, we also think through the past. The possibilities of the present are shaped by the forging of public knowledge practices of science—the ways that scientific ideas enter the public realm through media, politics or custom.

Certain issues have remained stable as a focus for popular science. Questions of health have long been in the headlines. Appropriate legal frameworks for vaccination were a

---

[2] Secord, *Visions of Science*, 2014, p. 1.

subject of interest throughout the nineteenth century and they remain so today. Other issues are recognisable but with very different details. The development of the northern regions of Australia is still a concern, but likely to be seen today through an environmental lens rather than the racial one of the late nineteenth century.[3] Still other matters are emerged anew—climate change, genetically modified food crops, and appropriate child-rearing practices[4]—or faded away entirely, like phrenology and animal magnetism.[5] All of these issues were, to a large degree, played out in public.

Astronomy is a particularly strong window onto science. Many of its objects of study are available to all. The movements of the heavenly bodies, and the appearance of spectacular apparitions afford a glimpse of scientific processes like few other sciences can. The visual experience of the night sky is part of everyday life, yet also understood as a focus for science. It is in part because of this that popularization has been a particularly strong tradition for astronomy compared to other sciences, and has been for a long time.

This strength of popular astronomy also arises through the role of visual media. 'Teaching through the eye' has been a powerful idea since the nineteenth century and nowhere was it more applied than in popularizations of the visual science of astronomy. Popular astronomy is thus a particularly strong case study of the role of media in popularization.

This thesis argues that those long cultural associations of astronomy have helped to shape the pasts and futures of Australia.

[3] Anderson, *The Cultivation of Whiteness*, 2006.

[4] Hudson and others, 'Public Attitudes to GM Foods', *Appetite*, 2015, 303–13; Fine and Rush, 'Why Does All the Girls Have to Buy Pink Stuff?', *Journal of Business Ethics*, 2016, 1–16.

[5] Darwin, *On the Origin of Species*, 1859; Romanes, *Darwin and After Darwin*, 1892.

1.1 The practice of popular science

The practice of popular science is a strange one. It engages simultaneously with two fields of culture that are themselves separated. On the one hand there is a public culture of print, image and performance, and on the other the more restrictive knowledge practices of scientists who, since the late nineteenth century at least, have partially defined themselves through their exclusive, *non*-popular characteristics. Understanding the relationship between these is not straightforward.

That these fields—of popular performance and elite science—are separated, and have quite distinct reward structures does not mean that there are no connections. Indeed much of the recent scholarship in the field of popular science has been directed to showing how practice in the popular sphere forms part of scientific work. However it is also the case that popular and elite science are not equivalent. Understanding both the connections between and the asymmetries of these practices is the goal of this section.

The role that popularization can play within scientific research is one understanding of the academic field of popular science studies. Another is the widespread agreement over the difficulties of the field. Criticism of the disciplinary orientation towards popular science studies has been both early[6] and persistent.[7] The history of popular science is "more haunted by its methodological problems than convinced of its strengths".[8]

[6] Cooter and Pumfrey, 'Separate Spheres and Public Places', *History of Science*, 1994.

[7] Secord, 'Knowledge in Transit', *Isis*, 2004, 654–72; Topham, 'Rethinking the History of Science Popularization/Popular Science', 2009, pp. 1–20.

[8] Daum, 'Varieties of Popular Science and the Transformations of Public Knowledge', *Isis*, 2009, 319–32.

Some methodological problems are inherent to historical study. ‘Popular science’ was a genuine actor category throughout the nineteenth century—that is people at the time applied that classification—but historical actors are not always reliable analysts and historians still need to pay attention to the coherence of this concept. To include works, for example, from the seventeenth to twentieth centuries “in a single genre surely conceals more than it reveals”.[9] O’Connor suggests that we consider “umbrella-categories” like popular science as “convenient catch-alls denoting fields of interest, not heuristic tools”.[10] This concern about the impact of analytical choice has been a central one for humanities research in recent decades. One interest of this thesis will be to take up this challenge to open up the category of ‘popular science’ in an analogous fashion to the way historians of science have opened-up the category of ‘science’ itself.

Other problems in the study of popular science are unique to the field, and in particular the problem described above, of conceptualizing the relationship between popular and elite scientific cultures. This is not trivial: if the same practices of popularization matter to both domains, does that mean that each actually partakes in the same practices? Does popularization matter as much to each? Does popular science arise entirely from scientific culture, is it entirely part of popular culture, or something in between?

The literature contains examples of all of these attitudes. For example, cultural and literary studies have viewed popularization almost entirely from the lens of popular culture. While these fields have increasingly viewed popular science as a legitimate subject of interest,[11] they have tended to ignore the context of scientific production.

There has also been a long tradition treating this scientific context as utterly dominant. This viewpoint regards scientific knowledge as epistemologically privileged, and scientific practice as isolated from popular culture. This attitude—already seen in the time period of this thesis—is common in twentieth century historical and philosophical scholarship. The

9 Secord, ‘Knowledge in Transit’, *Isis*, 2004, 654–72.

10 O’Connor, ‘Reflections on Popular Science in Britain’, *Isis*, 2009, 333–45.

11 eg Leane, *Reading Popular Physics*, 2007.

consequence of this position is the diffusionist model of popular science wherein knowledge is created by scientists and then spreads in a diluted form to lay publics.

Scholars of popular science today are unanimous in rejecting this one-way flow: “Science *for* the people and the science *of* the people (or even *by* the people) have been inextricably intertwined”.[12] Instead, popular science is understood to exist on a continuum of communication between intra-specialist and truly popular audiences.[13] Yet there is no consensus on how to describe the asymmetries of cultural influence described by Topham.[14]

The most important work in the field of popular science studies has shown how ‘popular science’ sits between science and popular culture, enmeshed in both and providing a zone of circulation between them. There have been a number of approaches to doing this.

Much scholarship has shown how the realm of the popular has formed an important—even crucial—resource for scientific practice. It has been a source of tacit skills, such as botanical illustration;[15] as a zone for contesting or communicating ideas as shown by Fleck and Hilgartner in different contexts of medical science[16] or by Karnfelt with respect to views about ‘island Universes’ in astronomy;[17] or simply as a means of additional income for some scientists.[18] While this latter role seems mundane it no less significant

[12] Topham, ‘Rethinking the History of Science Popularization/Popular Science’, 2009, pp. 1–20.

[13] Bucchi, ‘Of Deficits, Deviations and Dialogues: Theories of Public Communication of Science’, 2008, pp. 57–76.

[14] Topham, ‘A View from the Industrial Age’, *Isis*, 2004, 431–42.

[15] Secord, ‘Science in the Pub: Artisan Botanists in Early Nineteenth-Century Lancashire’, *History of Science*, 1994, 269–315.

[16] Fleck, *Genesis and Development of a Scientific Fact*, 1981; Hilgartner, ‘The Dominant View of Popularization’, *Social Studies of Science*, 1990, 519–39.

[17] Karnfelt, ‘The Popularization of Astronomy in Early Twentieth-Century Sweden: Aims and Motives’, 2009, pp. 175–94.

[18] Ibid.

for that—particularly for women in the nineteenth century, writing being one of the few ways they could enter the scientific world respectably and independently.[19]

More substantially, popular practices have shaped the possibilities of scientific practice itself. One of the best examples is Bigg's demonstration of the role of popularization in the creation of a disciplinary identity for the astrophysicists who sought to differentiate themselves from more traditional astronomers.[20] Nall has developed the idea of "imaginative astronomy" as a specific form of astronomical practice that attempted to unite rigorous matheatical reasoning with analogical reasoning, in which communication through the mass media was a crucial component.[21]

Substantial as this work is, it does not entirely address the question of how to understand the action of popular science on *both* scientific and popular cultures. Studies of popularization should aspire to make the space between scientific practice and popular culture more central to the histories of both and preserve the best understandings of science as situated knowledge without retreating to "parochial antiquarianism".[22]

I will in this thesis adopt Broks' suggestion to "look for the science in what was popular rather than the popular in what was science"[23] (referred to throughout as 'Broks' dictum'). There are dual motivations for following this this principle. Firstly, it avoids the problem of the diffusionist model wherein the zone of popular culture is treated as subordinate to the zone of scientific knowledge. Instead, popular culture is considered to have autonomy in the way that it perceives and develops scientific ideas. On the other hand, the focus on the scientific points back to the field of scientific practice and suggests that these domains are in fact connected. A simple principle like this cannot solve the deep-seated

[19] Lightman, 'The Visual Theology of Victorian Popularizers of Science', *Isis*, 2000, 651–80.

[20] Bigg, 'Staging the Heavens: Astrophysics and Popular Astronomy in the Late Nineteenth Century', 2010, pp. 304–24.

[21] Nall, 'News from Mars', PhD thesis, 2013, pp. 24, 35.

[22] Secord, 'Knowledge in Transit', *Isis*, 2004, 654–72.

[23] Broks, 'Science, Media and Culture: British Magazines, 1890-1914', *Public Understanding of Science*, 1993, 123–39.

methodological problems of the field, but it does direct our analytical gaze in a fruitful direction.

This thesis extends these insights to the study of popular astronomy. Astronomical popularizations were significant, in part, because their audiences understood them to be a revealing way of thinking about nature. They did not unquestioningly believe popularizers, or fail to appreciate the literary and artistic devices deployed by them. Evidence of audience scepticism will be presented in this thesis, such as in the satirical responses to Richard Proctor described in § 3.7.2. Nonetheless, the media technologies of popularization enabled a process of learning and discovery that was more involved than any other that many in the audience would otherwise have experienced. The magic lanterns projecting slides of stars and planets *were* their telescope on the universe.

This observation implies that there is not a sharp boundary between the practices of elite, or professional, scientific research and those of popular science. This point is made well and variously in the study of popular science.[24] My meaning is that the issues in thinking about learning in popular science are strongly related to the issues in thinking about discovery in scientific research. To paraphrase Latour,[25] if we are to let things matter in our thinking about scientific discovery, then we must let media representations of things matter in our thinking about popular science. I will return to this argument in § 1.3.

The problem described in this section, of characterising the interaction between popular and scientific cultures, is well appreciated in the study of popular science. A study of popular astronomy also reveals more specific problems. The next section outlines the central problem of multiple timeframes.

[24] Daum, 'Varieties of Popular Science and the Transformations of Public Knowledge', *Isis*, 2009, 319–32; Bensaude-Vincent, 'A Historical Perspective on Science and Its "others"', *Isis*, 2009, 359–368; Topham, 'Rethinking the History of Science Popularization/Popular Science', 2009, pp. 1–20; Bucchi, 'Of Deficits, Deviations and Dialogues: Theories of Public Communication of Science', 2008, pp. 57–76.

[25] Latour, 'For David Bloor... and Beyond', *Studies in History and Philosophy of Science Part A*, 1999, 113–30.

1.2 The problem of multiple timescales

One of the most striking things about reading nineteenth century popular astronomy is just how much of it invokes a cultural tradition that has remained stable over time. Many of the themes invoked by popularizers then are still in common use: the possibilities of life elsewhere, the destructive potential of cosmic forces, the insignificance of humans in the scale of the universe. Some experiences, too, are stable: the image of Saturn presented to a street astronomer's customer has not changed considerably in a century and a half.

Yet the change in the details is also significant. The actual subjects discussed by popularizers have changed enormously. The pace of new topics and discoveries in astronomical science was rapid in the nineteenth century and has accelerated in the twentieth. Late nineteenth century popularizers were interested in nebular theory and spectroscopic discoveries, issues of marginal importance for today's popularizers, while modern staples like black holes and big bang theory were entirely unknown. Interest in the Sun, the Moon and the planets of the solar system has remained constant over this period but even here there are changes. Nineteenth century questions of whether the Moon is a living or dead planet, or what is the nature of the Sun's surface seem quaint when whiggishly viewed from a twenty-first century vantage point. The images available to the imaginations of our planet-watchers have changed enormously.

Nineteenth century popular astronomy thus presents as a discussion in which the words used are quite unfamiliar but the conversation hauntingly familiar. There are multiple timescales involved in this practice of popular astronomy: the rapid beat of scientific discovery set into the slower rhythms of cultural framework. Explaining how both of these can contribute to the development of practice is a particularly acute angle on the problem of how to relate the interactions of these separate but enmeshed domains.

Existing studies of popular science have not been well suited to addressing this aspect of the problem of relating the cultures of scientific discovery and popular meaning. However in this case the lacuna arises not from reluctance but rather from a methodological strength of the field.

Studies of the history of popular science emerged[26] in the 1980s, at a time when science historians were increasingly oriented towards the disciplines of history and sociology, and away from the older style of the philosophy of science: “a break of the link that had tethered empirical studies of science from the concerns of classical epistemology”.[27] Concurrent developments included interests in microhistorical techniques and ‘the cultural turn’ within history, and the rise of the new field of science studies, including Actor-Network Theory (ANT). All of these factors turned attention away from earlier concerns with epistemologies, mentalities and internal histories, and towards the role of the local and immanent in knowledge production. One consequence is that histories of popular science have been mostly organized around particular people, media or events.

The achievements of these studies are considerable. The best of the microhistories[28] “can see the universe in a grain of sand, illuminating cosmic themes on hand from a single, richly described episode”.[29] Indeed, to “follow the agents themselves”[30] is a sure way of avoiding many of the traps of research.

Nonetheless this microhistorical work is ill-equipped to address the problem of multiple timescales. For this, a more extended historical sweep is required. There has been recent recognition of this within the field of the History of Science—a special issue of *Isis*

[26] eg *Expository Science*, ed. by Whitley and Shinn, 1985.

[27] Golinski, *Making Natural Knowledge*, 2008, p. 7.

[28] eg Ginzburg and others, *The Cheese and the Worms*, 1992; Davis, *The Return of Martin Guerre*, 1983.

[29] Daston, ‘Science Studies and the History of Science’, *Critical Inquiry*, 2009, 798–813.

[30] Latour, ‘For David Bloor… and Beyond’, *Studies in History and Philosophy of Science Part A*, 1999, 113–30.

focussed on a debate over the lack of a "'big picture' of the history of science".[31] Although the specific proposal advanced by Lunteran for such a "big picture" received varying amounts of criticism several contributors noted some of the shortcomings of an exclusive focus on microhistorical work.[32] Nonetheless, to date works that have gone beyond this framework have been less common in the field—so necessarily more valuable here.

Two works are particularly impressive. Golinski's *British Weather and the Climate of Enlightenment*[33] impressively attends simultaneously to the details of individual experiences with meteorological science and how these sit within the broader development of British national self-understanding, medical ideas of climate, and the appreciation of enlightenment ideals in themselves: "In all these cases, experiences of the weather mirrored the circumstances of people at the time".[34] These experiences both shaped and were shaped by longer-standing cultural ideals. Daston and Galison's *Objectivity*[35] sits outside the field of popular science studies per se, but is nonetheless enormously influential within it. This work traces the development of visual cultures in science across the nineteenth century, showing how implicit understandings about the nature of images could shape practice over an extended period of time but importantly also how those understandings could eventually change in the face of new developments.

These works, in different ways, suggest the framework that has been described by Peter Burke[36] as *schemata*, and this is the primary analytical lens through which I will view the material of this thesis. In particular I will focus on persistent clusters of meanings that are widely (although not necessarily universally) shared within a given community and which are simultaneously learned beliefs, and guides to the interpretation of events, experiences and communications. I will refer to such clusters as *cultural schemata*.

---

[31] Lunteren, 'Clocks to Computers', *Isis*, 2016, 762–76.

[32] eg Fara, 'Object Lessons', *Isis*, 2016, 785–88; Küçük, 'Darnton's Cats, Bacon's Rifle, and History of Science 101', *Isis*, 2016, 793–95.

[33] Golinski, *British Weather and the Climate of Enlightenment*, 2010.

[34] Ibid., p. 171.

[35] Daston and Galison, *Objectivity*, 2007.

[36] Burke, 'Strengths and Weaknesses of the History of Mentalities', *History of European Ideas*, 1986, 439–451.

Concepts of schema, or multiple schemata, have a long history. Kant was one of the first to explicitly refer to schema, as a property of the mind that mediated between sense-experience and understanding. In the twentieth century more developed accounts of schema were given, in cognitive psychology by Bartlett, in art history by Gombrich, and in semiotics by Lakoff.[37]

These applications are all different, ranging from high-level social phenomena, such as expectations of marriage[38] through to the understanding of individual words or images.[39] However they do share several features: they concern meaning, and in particular the interpretation of novel situations, they are structured, and one schema can invoke other schemata.[40] These are the features I will use to define and identify cultural schemata within this thesis. Although a precise taxonomy of mental structures is beyond this thesis, and perhaps chimerical in any case, these criteria distinguish cultural schemata from shared opinions, on the one hand, through stability over time and strength by which they shape interpretations, and from mentalities or other forms of pan-cultural structurations through their ability to be consciously manipulated or rejected.

As suggested above, such approaches to schemata have been rare in the literature on popular science. One can find more substantial examples of this approach from other fields of history. One example is *The Pursuit of the Millenium*, Norman Cohn's study of revolutionary messianism in the Rhine Valley from the eleventh and sixteenth century.[41] In this book Cohn shows how elements of the Sybilline Oracles, a non-canonical scripture, were propagated and repeatedly reinterpreted to be able to motivate a succession of chiliastic groups committed to establishing a 'heaven on earth'.

[37] Bartlett, *Remembering*, 1932; Gombrich, *Art and Illusion*, 1959; Lakoff and Johnson, *Metaphors We Live by*, 1980; Lakoff, *Women, Fire, and Dangerous Things*, 1987.

[38] Quinn, 'How to Reconstruct Schemas People Share, From What They Say', 2005, pp. 35–81.

[39] Lakoff, *Women, Fire, and Dangerous Things*, 1987.

[40] Rumelhart, 'Schemata and the Cognitive System', *Handbook of Social Cognition*, 1984, 161–188.

[41] Cohn, *The Pursuit of the Millennium*, 1970.

Interpretation of the scriptural figure of the Emperor of Last Days is given from his origin in the fourth century Roman Empire to the thirteenth century where he was identified with the figure of Holy Roman Emperor, Frederick II. In doing so the schema of a political figure who would usher in the last days and the establishment of an earthly paradise is seen to become detached from specific political contexts and to be re-interpreted in new ones, and to survive and propagate over multi-generational timeframes amongst particular socio-economic groups.

I will apply this concept of cultural schemata to a study of popular astronomy. Specifically, I articulate the patterns of meaning associated with popular astronomy, and how they persisted or changed over this time period. These schemata are seen as broader than specific facts—*I saw a comet last night*—but less systemic than culture-wide grids or mentalities. Crucially, these schemata compass both conscious, and semi-conscious understandings—*I remember learning about comets (but not, perhaps, their deep cultural history)*—and guide new interpretations—*I now know not to be superstitious about comets (but they may kill me anyway).*

Despite the lack of attention given to such approaches previously, there are several advantages in using a schema approach to the history of popular science. Firstly it provides a way of considering shared understandings of historical subjects without reverting to an "obsolete"[42] theory of mentalities. The most important flaw avoided is that schema approaches do not require seeing collective mentalities as being a totalized—and thus largely unverifiable—aspect of past experience. Related to this is that changes in schemata can be understood more readily than change in mentalities can.

Secondly, cultural schemata help mediate between histories of ideas—which consider subjects to hold beliefs truly—and histories of ideologies—which regard beliefs as representative of deeper structural imperatives that are adopted by subjects for their

[42] Arcangeli, *Cultural History*, 2012, p. 48.

utility.[43] Popular science presents something of a puzzle for these viewpoints. Ideologies seem unable to deal satisfactorily with the aspect of discovery and novelty inherent in popular science, yet considering popular science purely as ideas risks isolating the practice from meaningful connections with the daily lives of non-specialist audiences. Cultural schemata suggest how to link new ideas with socially relevant meanings.

Thirdly is the challenge raised at the head of this section: the problem of multiple timescales. Cultural schemata provide a durable framework for interpretation of new facts and events, and in this way we can perceive the operation of the rapid timescale of scientific discovery and the slower change in cultural schemata within the operation of popular science.

Five cultural schemata relating to astronomy are described in this thesis: Australia is a land under the southern stars; astronomy tells of a sky that is a source of power and danger; astronomy gives insight into religion; astronomy is an exemplary science; and astronomy speaks to the human condition through the possibilities of life elsewhere. Five is a convenient number to hold in a thesis; no claim is made that this is a precise count. As Latour says, “The strategy in any research program is to distribute topics and resources in the most intelligent and fecund way”.[44] Indeed any atomistic understanding of concepts is incompatible with a schema account. Schema invoke other schema and in this fashion I will describe in this thesis the astronomical sublime as a combination of these schemata, although in other contexts it could be added to this list.

---

[43] Wickberg, ‘Intellectual History vs. the Social History of Intellectuals’, *Rethinking History*, 2001, 383–95.

[44] Latour, ‘For David Bloor... and Beyond’, *Studies in History and Philosophy of Science Part A*, 1999, 113–30.

1.3 Lantern slides and materiality

The third analytical focus of the thesis is the concern with visual and material aspects of popular astronomy. The magic lantern in particular had a strong association with popular lecturing in astronomy. One of the most engaging of all of the nineteenth century visual technologies, lantern slides were used by all of the prominent lecturers of the period. Illustrated books also had a significant role in the history of popularization, and the material trade in images, instruments, books and newspapers both shaped and reflected the spread of ideas and practices. These subjects will be particularly examined in Chapter 4 but the consequences of this analytical interest shape the thesis throughout. One example of this is the periodization for this thesis.

The historical period of interest of this study is from approximately 1825 to 1910. There are a number of ways of understanding this. Of prime importance, I see these years as the era of the lantern slide in Australia. The first lantern shows appear in Australia in the late 1820s. At the other end of the period, cinema's rise largely displaced lanterns as a public entertainment. In between lanterns were the most high-impact media form in common use. They are thus a key technology of interest in discerning how popular media affected knowledge practices, while tying the historical period to this lifecycle sharpens the focus on visual and material practices of popular astronomy.

More broadly, this matches a common periodization in Australian history. This starts with the demographic boom that transformed Australia from a penal society to a settler colonial one and continues through the gold rush. Its final decades encompass the 1890s depression, therise of the labour movement, and the early Federation period.

It is also from the beginning of this time that the term 'Australia' itself was applied to the country and I will use that name throughout this thesis while noting that notions of national identity shifted substantially throughout the period. Similarly I will refer to this period as 'colonial Australia' to emphasize its characteristics as predominantly a settler society; no implication is intended that twentieth century Australia was 'post-colonial' in its relationships with Indigenous people.

A third reason for this range is that it is epicentred around 1880, the year of the tours of two high-profile British popularizers, Richard Proctor and Professor Pepper. These were two of the most high-profile and professional popularizers of their day. Their practices were sophisticated and had a large impact. These are described in detail in Chapter 3, but it is important for the interests of this thesis to trace the meanings of popular astronomy for the generation before and the decades immediately after Proctor and Pepper.

An interest in visual and material technologies also suggests ways of developing the analytical framework of cultural schemata through a consideration of theoretical approaches such as Actor-Network Theory (ANT). This family of approaches, associated particularly with Callon, Law and Latour, is one of the most influential in the field of science studies. Despite the continued use of the term ANT, it should really be considered as "a moving target"[45] or "a disparate family of material-semiotic tools, sensibilities, and methods of analysis".[46] All of these authors have indicated the need for ANT to be reconsidered and reformulated. Latour has said "there are four things that do not work with actor-network theory; the word actor, the word network, the word theory and the hyphen".[47]

Concerned to find a symmetrical description of the social and the natural, ANT-like approaches are highly attuned to the presence and action of non-human actors, both animate (like the scallops of St Brieuc Bay[48]) and inanimate (like an automatic door

[45] Ibid.

[46] Law, 'Actor-Network Theory and Material Semiotics', 2009, pp. 141–58.

[47] Latour, 'On Recalling ANT', *The Sociological Review*, 1999, 15–25.

[48] Callon, 'Some Elements of a Sociology of Translation', *Power, Action and Belief: A New Sociology of Knowledge*, 1986, 196–233.

closer[49]). This attention to the importance of the object is one influence of ANT here: the roles of stars and telescopes, of weather and almanacs, of lantern slides and lithographic printing—of things—are important for this thesis. However it is not the most substantial one. Material culture has also been important for scholars from very different perspectives to ANT, such as the socialist realist positions of Benjamin, Mumford, and Winner.

The aspects of ANT that are most important for this thesis concern its understanding that in themselves, the "objects are relational contingencies".[50] In one of his reflections on ANT-and-beyond, Law discusses an example that is strikingly resonant with the interests of this thesis: Portuguese navigation. Law describes how the activities of each Portuguese vessel in the early modern period depended on a network of entities, "hull, spars, sails, ropes, guns, food stores, sleeping quarters and crew",[51] the breakdown of any one of which could cause the object of the vessel to disintegrate. Law particularly notes that "the navigational system – Ephemerides, astrolabe or quadrant, slates for calculations, charts, navigators and stars – can also be treated as a network."[52] It is this sense of knowledge practices as being a network that is important here. As will be discussed in Chapter 4, the intent of a schema approach to cultural history is not to return to an epistemological version of science studies, but rather to highlight the extent to which stabilised intellectual resources can be mobilised *as* resources within the broader cultural realm, just as surely as material forms like ropes and guns, or actants like disease pathogens.

That is not to underplay the differences between the analytical techniques applied in this thesis and those of ANT; in many respects they are significantly different. Yet the substantial results of ANT approaches are still an enormous influence on this study. The notion of objects as being constituted by both the macro and micro scales is a clear example that is relevant to an understanding of cultural schemata. Latour has described twin dissatisfactions of social science: those of investigating microscale interactions but

[49] Johnson, 'Mixing Humans and Nonhumans Together', *Social Problems*, 1988, 298–310.

[50] Law, 'Objects and Spaces', *Theory, Culture & Society*, 2002, 91–105.

[51] Ibid.

[52] Ibid.

realizing “that many of elements necessary to make sense of the situation are already in place or are coming from far away”,[53] and that of then examining the structural forces only to find that “one needs to reconnect, through an opposite move, back to the flesh-and-blood local situations from which they had started”.[54] This describes well many of the case studies in this thesis: the symbolism of the Southern Cross described in § 2.2, forged through the experiences of migrants on rolling ships in the mid-Atlantic, but carrying notions of antipodes from the past and ideals of progress and democracy into the future; or the cultural schema of comets in § 2.5.1, expressed through particular observations with specific spectroscopes but bearing the trace of the astronomical sublime from across the centuries.

Mental structures like these, stabilised and propagated through cultural practices, should not be seen as idealised concepts which have force by virtue of equivalence of meaning to everyone, or as being projections of a social or a natural reality on our thinking, but rather as assemblages which matter because they allow people to *do* things. The circulation of these entities, rather than their stability, must be a focus on any such analysis. Cultural schemata draw on knowledge, tradition and experience in a way that has impact only through being re-enacted through local sites, and in particular through the presence of paper, glass, theatres and voice.

[53] Latour, ‘On Recalling ANT’, *The Sociological Review*, 1999, 15–25.

[54] Ibid.

1.4 Scope of thesis

Following Broks' dictum requires an open-ended investigation; a thesis needs to be bounded. To truly follow the popular would lead to a never-ending chain of discovery. Accordingly, a number of subjects that would properly be of interest to a broader research program have been excluded from consideration here. The most important of these will be mentioned now; others will be described as I touch upon them.

The focus of this thesis is primarily on the dominant public cultures of colonial Australia, especially as expressed through print and visual media. As such, little attention is given directly to Indigenous Australian knowledge traditions relating to astronomy. This is not because these traditions were unimportant or without influence. Encounter with Indigenous knowledge distinctly shaped colonial knowledge practices in ways unrecognised by practitioners who self-consciously situated themselves within a European tradition. The field of settler colonial studies has explored how colonists' experiences of place cannot be understood without reference to the Indigenous peoples they joined, and the late-nineteenth century colonial interest in race referred to in the introduction to this chapter derived largely from the non-Indigenous identity of settlers.[55] Colonial Australian obsessions with racial suitability for a 'foreign' land has already been mentioned.[56] The patterns of development in Australia, rural industries and even the road network were all, in part, guided by Indigenous knowledge of country.[57] Indigenous actors were also present in the performance contexts described in this thesis,[58] the

[55] Veracini, *Settler Colonialism*, 2010; Mar and Edmonds, 'Introduction', 2010, pp. 1–24.

[56] Anderson, *The Cultivation of Whiteness*, 2006.

[57] Clarke, *Aboriginal Plant Collectors*, 2008; Kerwin, *Aboriginal Dreaming Paths and Trading Routes : The Colonisation of the Australian Economic Landscape*, 2010, pp. 159–63.

[58] Waterhouse, *From Minstrel Show to Vaudeville*, 1990.

Indigenous material culture relating to astronomical ideas was substantial.[59] Many of these stories have been well told elsewhere and some remain to be told—but not here.

Amateur astronomers provide minor but valuable evidence for this thesis. In many cases amateurs were amongst the strongest popularizers, including Alfred Barrett Biggs, Dr Bone, William Macdonnell and Thomas Roseby. Other amateur traditions entered the public realm, such as the cometary discoveries of John Tebbutt, the dispute about Eta Argus entered into by Francis Abbott, and the reputation of the street astronomers in the major urban centres who would make money from showing passers-by views through their telescopes set up in public. Many amateurs gave regular observation sessions for members of the public while others actively answered public queries sent by mail.[60] Yet on the one hand, few amateurs had the national profile of a Tebbutt, while at a local level, amateurs were only one source of activity, alongside schoolteachers and clerics, for example.

Mirroring this overlap between popular and amateur astronomy is the use of a range of overlapping terminologies—perhaps unsurprising for a field that cannot agree whether to keep using its own name. This thesis takes as its focus *popular astronomy*: the development, circulation and consequences of astronomical ideas in popular culture, particularly with reference to visual and print media. Other related terms include *professional*, or *elite* science; *amateur* science; *public* science; *informal* science; and *citizen* science. Since these terms are important within the literature on popular science, and recur through this thesis, it is worth giving a description of my meanings for them.

The most important and difficult distinction is between *professional*, *elite* and *amateur* astronomy. Important because by the end of the time period it was one of the major ways in which practices of astronomy were organized; difficult because the distinction only

[59] Johnson, *Night Skies of Aboriginal Australia*, 1998; O'Connor, 'Reflections on Popular Science in Britain', *Isis*, 2009, 333–45; Hamacher, 'On the Astronomical Knowledge and Traditions of Aboriginal Australians', PhD thesis, 2011.

[60] Orchiston, 'The Role of the Amateur in Popularizing Astronomy', *Australian Journal of Astronomy*, 1997, 33–66.

appeared through this time of interest. At the beginning of the nineteenth century in Britain—with the exception of the Astronomer Royal—all major scientists were amateur; there was no such thing as a class of professional scientists. (The word scientist itself was not coined until 1833.) These categories were thus produced through the nineteenth century and retrospectively applying them is fraught with danger. On the other hand, the lack of a clear distinction did not mean that no differences in status existed. Both in—and between—Australia and Britain such hierarchies can be discerned, with some scientists closer to centres of power than others, through membership in societies, political influence or cultural prestige. Although its use does not obviate the difficulties described here, I will tend to use the term *elite* science to express this distinction of status.

A particularly important term is *public* science. Turner attempts to overcome the vexing distinction between professional and amateur science by recasting the field in these terms in his description of the three stages in nineteenth century British science: first as a form of useful knowledge; second in a contest with religion for cultural supremacy; third as co-opted by the state for the purposes of nation-building[61] While these broad trends are a useful guide, the implicit periodization is even more blurred in colonial Australia than it was in Britain. I will, instead, use the term *public* science to denote the discussions of science in the public sphere that are deployed towards advancing political questions or elucidating the relationships between science and society rather than describing the intellectual basis of the science. An example of public science is given by Governor Hotham's address at the laying of the foundation stone at the University of Melbourne in 1854 used to justify the institution:

> This country requires science for the development of its resources. You know nothing about what is in the bowels of the earth; you know nothing about your coal formations; you know there is copper in another colony, you say there is tin in this and iron too, and no doubt all this is reasonably founded, but you must have science to develope [sic] these resources.[62]

---

[61] Turner, 'Public Science in Britain, 1880-1919', *Isis*, 1980, 589–608.

[62] 'The University and the Public Library', *Argus*, 4 Jul. 1854.

These matters of public science are relevant to this thesis, albeit that my attention is given to the way such matters informed the public culture, rather than any implications for a political or institutional history.

Distinctions between the other terms are less important for this thesis. *Informal* science refers to scientific observation that is not directed towards sustained knowledge generation. Public telescope viewing sessions, or observations of eclipses are examples of these. As suggested above, these will be of interest only insofar as they extend into the broader public sphere of popular science. *Citizen* science, on the other hand, includes participation by non-specialists in directed research activities. This has become more prominent in the latter part of the twentieth century and early twenty-first century, but similar activities were certainly present in nineteenth century. One example is the network of correspondents of Darwin such as pastoralist Templeton Burnett and teacher Archibald Lang in the development of his book *The Emotions of Man.*[63]

[63] Butcher, 'Darwinism and Australia', PhD thesis, 1992.

1.5 Sources

This thesis addresses public culture. In doing so I have relied on public, private and institutional records: a lot of newspapers, quite a few manuscripts, and a small number of institutional sources.

The largest category of documentary evidence used in this thesis is public newspapers. Given that Australia in the nineteenth century was "the land of newspapers"[64] this is unsurprising. A combination of relatively high literacy rates and high incomes in Australia meant that "newspapers were the most eagerly read local publications".[65] Twopeny's estimate that the proportion of the population who were newspaper readers was ten times that of Britain was hardly scientific, but nonetheless gives an indication of the visibility of the press in colonial culture. Nonetheless nineteenth century newspapers are strange beasts, and their interpretation needs to be considered carefully.

The first point to note is that treating newspaper content entirely as representing some facts about the world, as an index to a state of affairs, misses a considerable part of the significance of these publications. In many cases what newspaper content represents best is, in fact, a culture of literacy. The need to fill large amount of column inches quickly, cheaply and reliably is evident in these publications. Hence the extended reports of sermons, meetings, annual reports and lectures, however factual they may be, presumably portray the editorial needs of the newspaper as much as they do any actual public interest in such events.

[64] Twopeny, *Town Life in Australia*, 1883, p. 221.

[65] Webby, 'Reading in Colonial Australia: The 2011 John Alexander Ferguson Memorial Lecture', *Journal of the Royal Australian Historical Society*, 2011, 119.

Nonetheless, for historical research, there is some interest in considering the content of newspapers as indexical. The text of these newspapers can be used in a number of different ways. Firstly, it can be considered as a factual claim about the events described in the newspaper. Secondly it can be interpreted as a reflection of opinion held by the author. Thirdly it can be viewed as a sample of the range of opinions of which the newspaper's readers were aware. None of these interpretations can be held as completely reliable, but they can fail in different ways. The first and second of these, for example, are concerned with the motivations and diligence of the writer, while the third is largely unconcerned with that. Indeed the second rests largely on that while the first can be tested in other ways as well: a newspaper account can be factually incorrect through a journalist deliberately misrepresenting their account, making an accidental mistake, or by being sincerely misinformed.

The dangers of relying excessively on the factual claims of newspapers is underlined by some of the interviews given by Richard Proctor, for example, in which he has clearly lied to reporters. One such case is the story Proctor told to the reporter writing the account for the San Francisco *Bulletin*, ultimately relied upon by Saum in his noteworthy study of Proctor.[66] This story appears to be incorrect in several details. Certainly it disagrees with the later account given by Smythe about when precisely Proctor met his second wife, and with Proctor's description that he was already in the throes of "domestic sorrow" by the time he reaches Australia, not to mention the documentary evidence in regard to the time and place of his first wife's death.[67] That the idea of Proctor lying in this manner has a plausible explanation—to defend the reputation of his second wife in her home town—lends weight to that interpretation, that it is inconsistent with other documentary evidence even more so. In any case this draws attention to the unreliability of sources, and the requirement for interpretive skill.

---

[66] 'A Scientist's Romance', *Sacramento Daily Record-Union*, 16 Apr. 1881, p. 1; Saum, 'The Proctor Interlude in St. Joseph and in America: Astronomy, Romance and Tragedy', *American Studies International*, 1999, 34–54.

[67] 'Social Notes', *Australasian*, 4 Jun. 1892, p. 38; 'Mr. Richard Anthony Proctor', *Argus*, 24 May 1880, p. 7.

The role of newspaper stories in the third aspect described above—as samples of public opinion—is less affected by these kinds of considerations, but has its own problems. In particular there is a clear danger of circularity in using newspaper reports to both justify and assess the significance of the events reported within them. The kinds of exclusions from the public sphere constructed by newspapers will include both the contingent—why one lecture may be reported while another not—and the structural—such as the biases against reportage of Indigenous Australian practices, or balance given to women's participation.

Richard Proctor again provides an example. A wide range of documentary and material evidence—not just newspapers but also pamphlets, correspondence, diaries, personal collections—attest to the undoubted cultural impact of this tour for many people. Nonetheless, the favouritism shown to him by the *Argus* and the *Australasian* over many years clearly was a contributing cause for this success as well as being a record of it. If this is tricky enough to interpret in such a clear case as Proctor's, it is even more fraught in more marginal cases.

Another aspect of nineteenth century newspapers is their highly multi-faceted nature. Individual titles certainly could, and did, pursue strong editorial lines. However newspapers then, as now, were an assemblage of many voices. Nor should the political leanings of the newspapers be treated too monolithically. Johnson reminds us that the political stances adopted by the *Sydney Morning Herald* under John Fairfax often represented more complex responses to local events, commercial imperatives, and overseas connections than the simple label of 'conservative' would suggest.[68] These editorial positions can also change over time, as shown by the *Argus's* abrupt shift in the 1850s from opposition to land interests and support for the immigrant gold miners to "old-womanish Toryism". Treated cautiously, this dynamic nature can be an advantage. Letters to the editor, for example, provide an additional, although not unmodulated, voice on the topics discussed within this thesis. Attending to the historical circumstances of—

[68] Johnson, 'The Shaping of Colonial Liberalism: John Fairfax and the Sydney Morning Herald, 1841-1877', PhD thesis, 2006, pp. 13–15.

and scholarly literature about—nineteenth-century newspapers can provide some redress here.[69]

A particularly fruitful application of newspapers is their indirect reflections of popularization within the culture. These include literary depictions, cartoons and satirical performances. The use of these devices is itself a mark of the impact of the original practice; a joke is rarely told if its teller does not expect the audience to understand. This aspect, bridging the second and third categories—honestly held opinions, and the spectrum of opinion publicly expressed—is also one of the strongest ways of following Broks' dictum: to look for the scientific within the popular, rather than the popular within the scientific.

While satire gives a strong reflection of audience reception a major concern about newspaper accounts is that they generally only fall under the second category described above—as the honest opinion of a known writer—and this is limited in many ways. Most newspaper reports are anonymous, and the tradition of attributed criticism that does exist within the publications has a particular conventional context related to theatrical performance. Nor can the honesty of these reports be considered to be unproblematic. Proctor's manager Smythe, for example, is known to have used his influence and contacts in Australian journalism to have favourable reports placed in newspapers.

Despite these limitations, newspapers still provide one of the richer sources of audience reaction; finding manuscript records of such responses is rare. This thesis does include several instances of these. These accounts can provide more extensive reflections that are differently modulated from the newspaper reports and thus extremely valuable. Here the concern is not to over-weight the evidence from such sources based on their rareness.

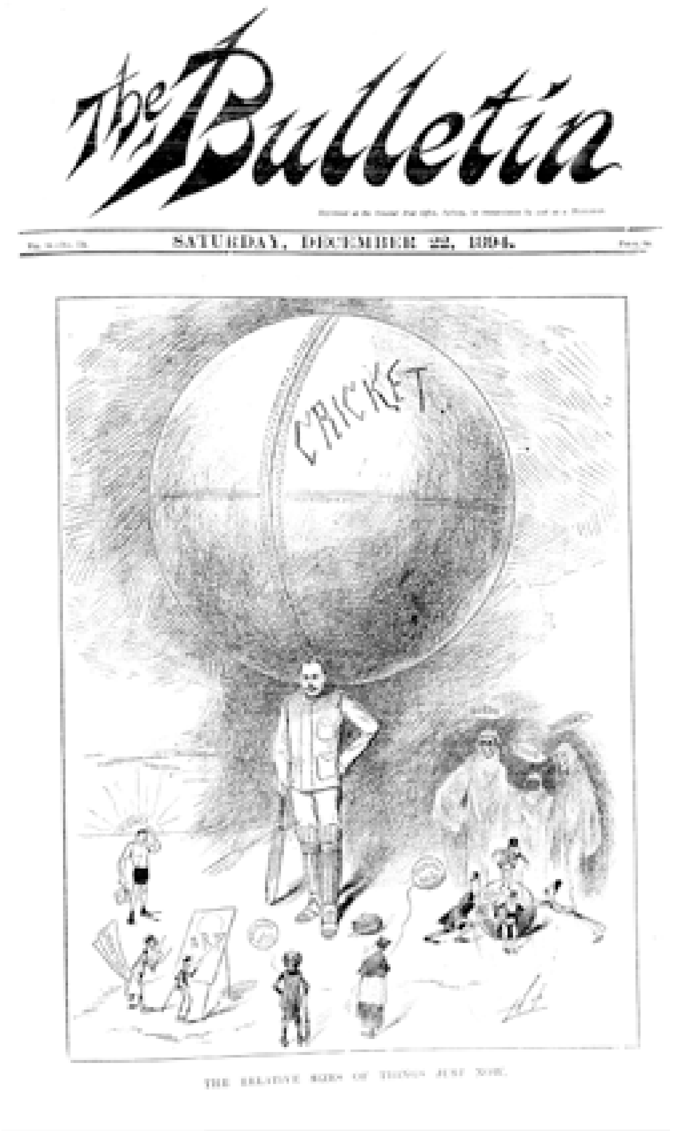
One source of personal writing that is rich within the archives is travel diaries. As will be described in § 2.2, many of these diaries describe, in their own ways, an experience of

[69] Russell and others, *Australian Newspaper History: A Bibliography*, 2009; Curthoys and Schultz, *Journalism: Print, Politics and Popular Culture*, 1999.

seeing the southern sky. This is an unusual example of a rich, easily discoverable source of personal writing directly relevant to the research question. There are, of course, biases here too. There is a substantial class bias with regards to the manuscript material surviving in archives today, which is to a large degree from established, wealthy families.

Institutional records play a relatively small role in this thesis. The records of government observatories reveal details of their activities, and of the interests of their astronomers. A particularly central category of records is the public letters sent to observatories, revealing the questions of interest to members of the public. However beyond this, institutional records rarely address the questions of content and meaning that are central to the research question. Nonetheless book catalogues and lists of lectures do attest to the relative presence of popular astronomy in the activities of institutions like public libraries or Mechanics' Institutes.

The problems for interpretation of historical texts derive also from the conceptual frameworks described earlier in this chapter. This thesis focuses on a particular practice—astronomical popularization—in a particular place and time—colonial Australia. It is not obvious that the experience of the historical subjects appreciated these categories; it is almost certain most understood them differently at least. This thesis will present evidence that both popularization and Australia were genuine actor categories; this thesis will also interrogate the differences in meanings of popularization and consider a diversity of forms of colonial identity. In any case the process of focussing on these aspects concentrates them. One reminder of this bias is given by the cartoon in Figure 1.1. Attending to the bias between researcher interest and popular significance is an ongoing challenge. Maintaining a balance between source material on topic and source material illuminating the relevant context is a question of historical judgement. Maximising the advantages of historical studies while addressing its limitations is a necessary goal; achieving it much less certain. I aspire to reaching that balance in the remaining chapters of this thesis.



Source: State Library of Victoria

Figure 1.1 'The Relative Size of Things', 1894

This cartoon was published on the front cover of the *Bulletin* on 22 December 1894. According to the cartoonist, Livingstone (Hop) Hopkins, politics, religion, art and literature, are all small things in the public mind in comparison to cricket. So too is science, represented by a rising sun.

While clearly satirical, this is a reminder of an important issue. A study such as this necessarily focuses on a bounded domain of subject matter. In lived experience, however, this domain is inseparable from wider contexts. This cartoon is thus a reminder of the distortions that can be produced by the analytical gaze.

2: A survey of Australian colonial popular astronomy

The cultural schemata of popular astronomy in colonial Australia are succinctly expressed in mathematician George Stokes' presidential address to the British Association for the Advancement of Science (BAAS) meeting in August 1869:

> The movements of the heavenly bodies must have occupied the attention and excited the interest of mankind from the earliest ages, and, accordingly, the first rudiments of the science are lost in the depths of antiquity. The grandeur of the subjects of contemplation which it presents to us have won for it special favour, and its importance in relation to navigation, has caused it to be supported by national resources. Newton's great discovery of universal gravitation raised it from the rank of a science of observation to that of one admitting of the most exact mathematical deduction[70]

This thesis traces these cultural schemata across the nineteenth century and shows that all of them had a stability within culture that went far beyond the specific knowledge practices of science or the institutional changes of the nature of science in the public domain. This supports the argument that science popularization needs to be understood as an interaction between the relatively rapid timescale of knowledge generation and the longer scale of the cultural tropes within which this knowledge is presented and represented.

---

[70] 'The Meeting of the British Association', *Sydney Morning Herald*, 19 Nov. 1869, p. 6.

That the cultural schemata expressed by a British scientist in 1869 were present in colonial Australia underlines that popular astronomy was one kind of knowledge tradition that, to a first approximation, was inherited from British practice. All of these cultural schemata about astronomy outlined by Stokes will be explored in this thesis: the focus on the history of thought about astronomy, the sense of the astronomical sublime, reliance on its practical applications, and an emphasis on the British heritage of astronomical science. However these schemata appeared in diverse forms, and evolved in more or less distinct ways in the colonies. Australia as a land under the southern sky was a fifth schema of popular astronomy that will be articulated here. Both the connections with British practice and the unique manifestations will be studied in this thesis.

This chapter introduces the empirical section of that study, which is continued over the next three chapters. The structure for the content of this section is partly chronological and partly thematic. This combination is based on those changes in the way science appeared in the public arena. Some of these have already been described in § 1.4: science changed from an area dominated by amateur gentlemen and clergy, to a field of practice comprising an identifiable professional class of scientists with substantial institutional bases of support. Other important changes will be detailed later, notably in Chapter 4: the growth of the lantern slide trade and cheaper books, magazines and newspapers meant that media products were far more widely available at the end of this time period than at the start. Allied to this were the educational, social and economic developments that formed a literate, and increasingly urbanised population in Australia by the first decade of the twentieth century. For all of these reasons, the nature of what is "scientific in the popular" shifted through the nineteenth century.

These common understandings of astronomy derived not from BAAS addresses or detailed study but from quotidian practices: conversations, newspapers and magazines, theatrical productions and other popular entertainments, school instruction, as well as personal experiences of the sky in travel, at home, with weather, and the folk traditions that surrounded these experiences. To understand how popular astronomy impacted Australian society, and how popularizers were able to shape these understanding, this chapter considers the representations of astronomy manifested through these practices.

There are six examples of popular astronomical understandings within this broad sweep that will be explored further in this chapter. These have been selected both to cover the gamut of kinds of experience, and according to particular criteria of significance. The special interests of this thesis on visual and material culture, also help guide the choice of case studies in this chapter.

The first area of popular understanding I will explore is the use of astronomical symbolism in Australian flags and arms, and more broadly the role of astronomical knowledge in place-making in Australia. This is based on the cultural schema of Australia as a land under the southern sky. The emotional resonance of astronomical symbolism as a representation of nationhood for Australia has remained strong over a long period of time despite large changes in both the meanings attributed to this symbolism and the tacit knowledges and experiences on which these meanings drew. This case study thus considers an example of astronomical knowledge that is near-universally understood in Australia, and was so over the entire time period of this thesis.

Astronomy was involved not just in symbolic place-making; it was central to the technologies of colonialism. Astronomy was a central science for both the navigational practices that allowed travel between widely separated parts of the globe and the surveying that allowed Australia to be divided up amongst the colonists. Astronomy also laid a foundation for the timekeeping that facilitated industrial organization of penal colonies, coordinated markets and urban life. These technologies also fed into the schema of Australia as a land under the southern skies but more importantly they helped place astronomy within a broader schema about the value of scientific knowledge as useful and practical. The way that the astronomy underlying these socially powerful technologies entered into popular understandings will be the subject of the second case study of this chapter.

The interest in the third case—astronomical events such as the appearance of great comets—was episodic, and each event was relatively ephemeral. Nonetheless these events generated some of the most intense interest and involvement of any astronomical association in culture. Moreover, the cultural schemata associated with comets, in particular, show most clearly the multi-generational timeframe over which they operated. Interest in other events, like eclipses and transits, invokes the cultural schema of astronomy as an exemplary science, the one that has discovered ‘the true law of the solar system’. This case study therefore looks at the most intense and explicit way in which popular practices engaged with astronomical knowledge.

The fourth case study, which fulfils Broks’ dictum even more closely, considers the associations between the sky, weather and astrology, especially as reinforced in almanacs. Concern with the weather and climate of Australia was probably the most interesting aspect of the sky for colonial Australians. This case study thus most nearly traces ‘the scientific in what is popular’. It also provides a focus on the cultural schema of astronomy as speaking to the sky that is a site of danger. While the association of astronomy and the sky with the power of the weather has endured, specific associations with almanacs or astrology have been more variable as the material forms of these practices changed substantially.

The fifth and sixth case studies look at the daily practices of formal and informal education and how these cultural institutions were involved in popularizing astronomy. A focus on the circulation of material and visual culture underlies these areas as well, although a consideration of the most significant forms of these cultural products, such as lantern slides and popular astronomy books will be deferred to Chapter 4. This chapter will outline some of the institutional settings in which these products were deployed. These will include informal education within the Mechanics Institute movement and astronomy in the curricula of colonial schools, and specifically at the subject ‘The Use of the Globes’. Astronomy was an attractive subject within the Mechanics’ Institute in particular due to a number of its associations including the cultural schemata of astronomy as giving insight into religion and astronomy as the exemplary science. The trajectory of popular astronomy within the institutions studied in these case-studies also shows the influence of social histories on the development of popular knowledge practices.

2.1 An overview of colonial knowledge practices

Each of the case studies of this chapter needs to be considered within the broader context of knowledge practices in colonial Australia. This section describes that context and how these knowledge practices have been studied in the literature.

Interest in scientific topics can be seen in the Australian colonies from the beginning of the time period of this study. (For a discussion of earlier popular science in Sydney, including consideration of the interaction with Indigenous Australian knowledge traditions, see Orthia.[71]) The first regular columns on science appear in both major Sydney papers, the pro-government *Sydney Gazette* and the oppositional *Australian* in the 1820s. These columns, typical of many similar, consisted of short fragments assembled from British journals. By the 1840s, such columns were common in many newspapers across the country.

The first original reporting of local scientific investigations in the Australian press was from the pen of the “father of Australian science” the Rev. William Branwhite Clarke.[72] Primarily this appeared in the form of letters to the editor on subjects such as earthquakes, meteorology and comets although by the end of the 1840s the newspapers would occasionally carry more extended reports written by him. So prominent did these letters become that correspondents were soon writing letters to the editor with questions that specifically addressed “W. B. C.”, in hope for an answer. Another science column from this time notable for containing some original reportage was published in the

[71] Orthia, ‘Laudably Communicating to the World’, *Historical Records of Australian Science*, 2016, 1–12.

[72] Organ, ‘W.B. Clarke as Scientific Journalist’, *Historical Records of Australian Science*, 1992, 1–16.

Bathurst Advocate[73] and written by Frederick Sinclair who, on his death in 1904 would be described as "one of the oldest journalists in New South Wales".[74]

Scientific interests were of course pursued through other avenues than the newspapers. By the time that Clarke arrived in Australia the first Mechanics' Institutes had already been established and these were a focal point for popularization. They will be discussed further in § 2.6. Societies dedicated to original researches, such as the Royal Societies, came a little afterwards, apart from the short-lived Sydney Philosophical Institute. Reports and extracts of the events of all of these societies also appeared in the newspapers.

Commercial popularization appeared in the colonies from an even earlier time. This tradition is discussed by Hartrick in respect to magic lantern culture in Australia[75] and Colligan for the related world of panoramas;[76] Altick is a useful reference point for both.[77] As will be discussed in § 4.3 most of these early commercial ventures were moderately successful at best. It was not until 1880 that a clearly successful commercial popularizer appeared in the guise of Richard Proctor. His activities will be detailed in Chapter 3. (The public lectures given by the Rev. Dr Scoresby in Melbourne in 1856,[78] although not a commercial venture, were an earlier example of a celebrity speaker from overseas.)

The existing literature has little to say about this history. Although there is strong scholarship in both the history of Australian science and in cultural history, there is considerably less study of science *in* culture. Both disciplines have tended to shun the intersection in Australia, barring some notable exceptions. Cultural histories have focused on the poles of popular or high culture[79] with studies of visual representation in the

73 eg 'Scientific Memoranda', *Bathurst Advocate*, 10 Mar. 1849, p. 4.

74 'Obituary', *Australian Town and Country Journal*, 6 Jan. 1904, p. 55.

75 Hartrick, 'Consuming Illusions', PhD thesis, 2003.

76 Colligan, *Canvas Documentaries*, 2002.

77 Altick, *The Shows of London*, 1978.

78 'The Rev. Dr. Scoresby's Lecture—The Magnetism of Iron Vessels', *Argus*, 5 May 1856, p. 4.

79 Rickard, *Australia: A Cultural History*, 1988; Serle, *From Deserts the Prophets Come*, 1973.

colonial period particularly prominent in the latter.[80] On the other hand, Australian history of science has primarily been concerned with the question of institutional arrangements, especially the debate over the relationships between 'centre' and 'periphery'. The role of popularization in this history has been undervalued. For example Clarke's public role as a local 'gentleman of science' has received little attention.[81] Orchiston has considered the role of popular knowledge in a number of papers,[82] but it has not been the focus of his voluminous work on the history of astronomy. Gillespie does provide a nuanced account of the multiple factors involved in astronomical work, including a discussion about the public activities of Government Astronomer Robert Ellery,[83] showing how the Melbourne Observatory was "part of a social and cultural network in Melbourne as much as it was part of an international astronomical network"[84] but attention is nonetheless fixed on the Observatory itself.

Nor have broader Australian histories provided much support in directly addressing this intersection. Interests here have been organized around notions of class—and the associated rise of the labour movement in the later part of the nineteenth century—and, more recently, gender and Indigeneity. Nonetheless, these histories are important context.

Class interests in Australian history are shown though analyses of subjects such as the first major political question in Australia, the rights of ex-convicts, or emancipists. The authoritarian governance structures of a penal colony lingered in Australia and so through the middle parts of the decade this question transformed into broader ones over responsible government and the franchise, such as the Eureka dispute which will be described in § 2.2.8. The most significant political question in the latter decades of the

80 Smith, *European Vision and the South Pacific*, 1950.

81 A notable exception being Organ, 'W.B. Clarke as Scientific Journalist', *Historical Records of Australian Science*, 1992, 1–16.

82 Orchiston, 'The Role of the Amateur in Popularizing Astronomy', *Australian Journal of Astronomy*, 1997, 33–66; Orchiston, 'Australia's Earliest Planispheres', *Journal of the British Astronomical Association*, 2003, 329–332.

83 Gascoigne, 'Ellery, Robert Lewis (1827–1908)'.

84 Gillespie, *The Great Melbourne Telescope*, 2011, p. 128.

nineteenth century is generally considered to be that of land ownership, specifically the rights of the major land owners—the squatters—who established their properties early, and in most cases without authorization, against the free settlers who came later and wanted similar access to land. (The pre-existing ownership rights of Australians was not a political concern for either group.) A major basis for radical politics in Australia at this time were the single-tax leagues, which aimed to socialize the ownership of land through taxation.[85] These leagues contributed significantly to the rise of the labour movement, which itself became the most prominent focus of left-wing political activity at the end of the nineteenth century and beyond. These interests of social history in class and gender will be important for this thesis. As described in §1.4 questions of Indigeneity will not have a large presence.

An example of the importance of gender is how astronomy was a common topic in 'accomplishments education' for middle-class girls[86] and how this helped to shape audiences for popularization. Another example for class is the way that these social distinctions were manifested in culture. Largely because of the smaller market, performances in colonial Australia did not readily stratify themselves so many well-to-do colonials self-stratified by staying away. Well into the second half of the nineteenth century, theatres retained an air of disreputability in Australia considerably beyond the similar reputations in Britain itself. Both previous studies[87] and this highlight the importance of these theatrical histories[88] to a full appreciation of popular astronomy.

In order to understand the audiences and their reactions, attention does need to be given to class differences. Some class distinctions arose within Australia but many were established before migration. Free settlers were overwhelmingly British. (Germans were the largest non-British, and Chinese the largest non-European source). The cost of

[85] O'Farrell, 'The Australian Socialist League and the Labour Movement, 1887–1891', *Historical Studies: Australia and New Zealand*, 1958, 152–65.

[86] Theobald, *Knowing Women*, 1996.

[87] Huang, 'Commercial and Sublime', PhD thesis, 2015.

[88] eg Kardoss, *A Brief History of the Australian Theatre*, 1955; Waterhouse, *From Minstrel Show to Vaudeville*, 1990.

migrating to Australia was around ten times that of a passage to America. Even given the assistance received by about half of the migrants in the nineteenth century, this cost was a significant barrier to the poorest and the most alienated. Richards has documented ways in which some of this underclass was able to make the journey, but even he concludes that "'the poor' must have been a fraction of a minority".[89]

Migrants to Australia were therefore more likely to be at least semi-skilled, and more likely to maintain active relationships with family 'at home' or at the least with the idea of Britishness than migrants to other places. Many migrants to Australia during the gold rush would echo the sentiments of Thomas Gibson Henry, that gold "nuggets would soon perhaps give me a chance of returning a bloated aristocrat".[90] Henry would not return to Britain, bloated or otherwise, but remained in Australia for the rest of his life. This experience, too, was typical for many migrants in the gold rush era. Australia at this time was populated largely with people who had always intended to return to Britain (or elsewhere) and hence saw the value in maintaining British (or other) traditions.

These factors significantly complicate any simple idea about the relationship of class and culture in Australian society. The pastoral industry was dominated by large oligarchic interests, yet the influence of Chartist ideals amongst new migrants was strong; as much as anywhere political settlements have been driven by the interests of the wealthy, but more than most places the cultural accommodations have been influenced by democratic ideals. Early industry in the colony was labour-intensive, the workforce far more mobile than in Britain and many traditional practices had to be modified in a new environment.

Migrants explicitly retained connection to 'home' yet there is a strong sense of creating a new society. Communicative technologies were keenly understood in Australia and new developments in these technologies were embraced enthusiastically.

---

[89] Richards, 'How Did Poor People Emigrate from the British Isles to Australia in the Nineteenth Century?', *Journal of British Studies*, 1993, 250–279.

[90] Henry, 'Journal Kept by Thomas Gibson Henry on Board the (?) En Route to Australia from Ireland in 1835', 1835.

All of these factors placed an emphasis on practical knowledge. “We are a practical people” declared the *Journal of Australasia*, proudly: “We have little affection for the ideal and the imaginative; and we are also rather proud of this defect in our national character.”[91] To be sure, such claims were by no means unique; exactly the same formulation can be found in contemporary British publications,[92] and complaints from scientists about “the people who demand of science practical uses” [93] are just about as old and just as widespread. Indeed, this emphasis on practicality was itself a major cultural schema within Victorian society about knowledge practices in general including, but going well beyond, astronomy; MacLeod traces its rise—and the opposition to it—as well as some of its specific manifestations in an Australian context.[94]

Yet many Australians understood science to be an aspect of this practical knowledge, as expressed by Hotham’s speech at the opening of the University of Melbourne quoted in § 1.4. Previous studies, too, have emphasized the practical orientation of much colonial Australia’s support for science.[95] It is, perhaps, due to attitudes towards science and technology that Australia has been described as fundamentally Benthamite in its political culture.[96] However this connection is explained, it is clear that a practical but progressive attitude towards science was strongly expressed in Australia in the colonial period. Astronomy played a prominent part of those attitudes.

[91] ‘Our Buildings’, *Journal of Australasia*, Aug. 1856, 49–52.

[92] ‘It Can’t Be Done’, *Spectator*, 29 Aug. 1846, p. 830; Mackay, ‘A Discourse on Poetry and on the Duties of the Poet’, *The People’s Journal*, 1847, 108–12.

[93] Tyndall, *Fragments of Science for Unscientific People*, 1871.

[94] MacLeod, ‘The “Practical Man”’, *Australian Cultural History*, 1989, 24–49.

[95] eg Clements, ‘Science and Colonial Culture’, PhD thesis, 1999.

[96] Collins, ‘Political Ideology in Australia’, *Daedalus*, 1985, 147–69.

2.2 Astronomical symbolism in Australia

The most notable cultural schema relating to the night sky in Australian cultural life is the notion of Australia as a land under the southern stars and in particular a persistent trope that associates one specific constellation with national identity. The Southern Cross has been a near-universally recognised emblem of Australia since the beginning of the colonial period.

Despite its ubiquity, the origins of this association have been little examined. This construction began as a element of instrumental scientific knowledge, developed through social processes of memory, practices of travel, and forms of religion, and became embedded into notions of identity, and ideas of global connection and difference. The development of this schema has many aspects and is revealing of the way cultural symbolism transforms: the specific meanings of the Southern Cross to early nineteenth century migrants to Australia were mostly obscured within only a couple of generations, yet as a conventionalised element the emotional connection remained strong. This section will describe these transformations.

2.2.1 Southern Cross

The Southern Cross emerged as an Australian emblem remarkably rapidly. By the 1820s, the Cross appeared on an Australian flag, and migrants were recording its appearance in travel diaries.[97]

The Southern Cross is indeed largely a southern hemisphere object in the current era.[98] The whole cross is never visible from any further north than 24°N, which includes all of Europe. Known—and important—to southern hemisphere peoples like Indigenous Australians since time immemorial, the constellation came to prominence in the European tradition with the voyages of the sixteenth century.

In that tradition, the Southern Cross was named first in Spanish (See Figure 2.1) and the focus of interest on the Cross in English tradition can be traced most directly from earlier Spanish and Portuguese navigational knowledge. The Southern Cross had been an integral part of Portuguese navigational practice since the 16th century *livros de marinharia*, or books of navigation.

The Cross first appears in the English nautical tradition in navigational manuals of the late sixteenth century that explicitly make reference to the Portuguese manuals or were direct translations,[99] such as the *Arte of Navigation*, the translation of Pedro de Medina's manual undertaken by John Frampton.[100] This work contained the first account in English of the Portuguese 'rule of the south' involving the Cross. Frampton uses the name "Cruzero" to refer to the Southern Cross. Earlier Edward Cliffe in *The Voyage of Mr John Winter into the South Seas* had used the name "Crociers" while throughout the seventeenth and eighteenth centuries, the most common name for the Cross in English

[97] Hellyer, 'Hellyer Journal - Illustrated Manuscript of "Voyage to Van Diemen"s Land, 1825' Original Manuscript', 1825.

[98] Slow changes in the Earth's orbit shift which stars are visible from the northern hemsiphere over time. Three thousand years ago the Cross was visible from southern Europe.

[99] Waters, *English Navigational Books, Charts and Globes Printed Down to 1600*, 1985.

[100] Frampton, *The Arte of Navigation*, 1595.

was "Croisiers" as in the *Mariners' Magazine* by Samuel Sturmy, the *Modern Navigator's Complete Tutor* by Joshua Kelly, or the *Epitome of the Art of Navigation* by James Atkinson.[101] All of these variations show the importance of the Portuguese tradition and as Humboldt observes, the knowledge and symbolism of the Southern Cross were still being communicated directly from Spanish and Portuguese mariners to other Europeans up to the nineteenth century.

The name "Southern Cross" first clearly appears in English at the beginning of the nineteenth century. *The Philosophical Transactions of the Royal Society of London, from their commencement in 1665 to the year 1800, Abridged and revised* of 1809, for example, translates de la Condamine's "Crucis Australia" as "the Southern Cross".[102] Although the term "Crosiers" is occasionally seen in English after this,[103] the "Southern Cross" very quickly becomes ubiquitous.

Despite its relatively recent 'discovery', a considerable European tradition developed around the Cross. There had been references to the Southern Cross in literature from Dante onwards. The most prominent discussion of the Cross in the English press in the early nineteenth century came from Humboldt's travel narratives, serialized in the *Edinburgh Review* in 1815 and the *Quarterly Review* in 1816. In these Humboldt had particularly drawn attention to the knowledge of Spanish and Portuguese sailors about the Cross: "a religious sentiment attaches them to a constellation, the form of which recalls the sign of the faith".[104] In particular, ideas about the influence of the southern stars on health and environment had been of considerable interest to the Spanish from the

---

[101] Cliffe, 'The Voyage of M. John Winter into the South Seas, by the Streight of Magellan', 1854, pp. 269–84; Sturmy, *The Mariner's Magazine*, 1669; Kelly, *The Modern Navigator's Compleat Tutor*, 1733; Atkinson, *Epitome of the Art of Navigation*, 1753.

[102] Hutton and others, *The Philosophical Transactions of the Royal Society of London, from Their Commencement, in 1665, to the Year 1800*, 1809, p. 664.

[103] 'Verses', *Sydney Gazette and New South Wales Advertiser*, 18 Nov. 1824, p. 4.

[104] von Humboldt, 'Personal Narrative of Travels', *The Edinburgh Review, or Critical Journal*, Jun. 1815, 86–111; von Humboldt, 'Personal Narrative of Travels', *Quarterly Review*, Jan. 1816, 368–402.

earliest days of South American colonisation, with the Southern Cross prominent from as early as 1517.[105] Although by the nineteenth century these astrological ideas were no longer credible, the layers of tradition wrapped around the Southern Cross maintained its prominence in South America, importantly including its use as a navigational aid.

The nineteenth century sources, abounding with references to the Cross, rarely give explicit descriptions of its purported significance. The most substantial discussion that does exist from the earlier colonial period is an article by nautical instructor Gustavus Dittmann in the *Nautical Magazine* in April 1836. Prussian by birth, Dittmann served in the British navy for 27 years between 1829 and 1856, and was naturalised as a British subject in 1853. Significantly, he served initially in South American waters. Dittmann describes in his article the various practical advantages in using the cross, as a timekeeper, as a way of learning to estimate angles, and so forth, as had been earlier described by the Portuguese *livros* and in Humboldt's account. He ended his article:

> Thus the Southern Cross and the Great Northern Bear prove to one or the other part of our globe, and jointly to the inhabitants of the torrid zone in particular, two radiant celestial clocks, never erring, and combining the properties of gnomon and dial with those of an invariable magnetic needle. The European Christian, moreover, who in a calm night is attentively watching the revolution of the Cross, involuntarily gets absorbed in religious thoughts. His dazzled eye beholds far from home a cluster of brilliant stars, the form of which he learned in his infancy to revere as a type of salvation. His mind naturally is carried back to the days that are gone, to all his earliest deeds, better feelings, and dearest affections. And the heavenly Cross of the South, thus, may often rouse slumbering germs of virtue, and create feelings of contrition in the heart of the travelling sinner or the transported felon.[106]

[105] Esguerra, 'New World, New Stars', *American Historical Review*, 1999, 33–33.

[106] Dittmann, 'On the Southern Cross', *The Nautical Magazine*, Apr. 1836, 214–25.

This paragraph captures many of the aspects of the Southern Cross that were so important to early colonialists and which formed the basis of the emotional attachment felt towards the constellation, an attachment that would be passed on even after these specific meanings had been almost entirely abstracted for later Australians.

The first point Dittmann makes is the complementarity of the Southern Cross and the 'Great Bear'. This was an important reference for European migrants to the southern hemisphere and will be detailed in the next section. The significance of the Cross for Dittmann goes beyond this. The celestial sphere appears to be "never erring", or in other words a perfect machine. It is in part due to this perfection that it is a worthy and uplifting object of interest. This idea of infallibility reinforces two other cultural schemata of astronomy: that it gives insight into religion, and that it is an exemplary science. These schemata will be described in § 2.6.2 and § 2.6.3 respectively. But the Southern Cross holds an instrumental value as well, as a 'gnomon' and 'magnetic needle' and thus joins the scientific and technical with the spiritual. For Dittmann the main value of the Cross is a practical one, able to tell the time or find directions. This placed astronomy in yet another cultural schema, one that was a more widespread aspect of Victorian popular knowledge practices, the idea that knowledge should be useful.

Figure 2.1 Andrea Corsali's Southern Cross, 1515

The Southern Cross has been considered the 'principal constellation' of the southern hemisphere for a long time. Exactly how and why it became such a focus is uncertain, but it seems clear that it arose and survived in Portuguese and Spanish maritime traditions. Down to the nineteenth century, many other Europeans learned of the constellation from those sources.

This image is taken from a letter containing what is thought to be the first European description of the Cross, by Andrea Corsali. Corsali was a Florentine although most of his travelling was done on board Portuguese merchant ships. In 1515 he wrote this letter to Guliano de Medici, in whose service he was.

2.2.2 Antipodes

A significant point of Dittmann's description is the complementarity that he draws between the Southern Cross and Ursa Major (otherwise known as the Great Bear). This relationship was commonly noted, both by scientists like Humboldt or lay observers alike. It is a neat coincidence that the two constellations lie close to the same meridian in the sky and equally distant from the southern and northern celestial poles respectively. The consequence of this is that from a latitude band that approximately stretches 20° either side of 10°N, at the appropriate times, both constellations can be partly seen in the same sky low over opposite horizons. From a smaller band around 10°N both constellations can be seen in their entirety. Moreover, as seafaring travellers passed south over successive nights, Ursa Major would be seen to sink out of sight as the Southern Cross rose increasingly into view. This experience was associated in time and space with 'crossing the line', an event usually reinforced through rituals and pranks.[107] The relationship between the Southern Cross and Ursa Major in the night sky is shown in Figure 2.2.

The pairing of the two constellations of the Southern Cross and Ursa Major underpinned the popular European understanding of the world as divided into two distinct regions: the northern and southern hemispheres. This is, of course, only one of an infinite variety of classification schemes, but it was a schema that had become naturalized for Europeans by this historical period.

The idea of antipodes—that is pairs of places on the globe that are directly opposite each other—and the mapping of the world into northern and southern halves both go back to ancient times. Philosophical speculations about the nature of this symmetry, and literary representations of the antipodes as 'world turned upside down' are almost as old.[108] Richard Brome's play *The Antipodes* is an example of this tradition in English culture.

[107] Richardson, 'Polliwogs and Shellbacks', *Western Folklore*, 1977, 154–159.

[108] Goldie, *The Idea of the Antipodes*, 2010.

The conception of northern and southern hemispheres is slightly different to that of antipodes. The latter is location-centred—two points are opposed—and nearby points are included in the classification of ‘same’ or ‘other’ by extension. The former idea, of hemispheres, starts with a shared identity over an extended region of space. It is likely that the extended region of ‘the northern hemisphere’ for nineteenth century British migrants rarely if ever took in a whole half of the world. The ‘northern hemisphere’ was in essence a construction of European identity. It is straightforward to point out that such a construction could not take root until encounters with beyond-Europeans became common. Precisely when this became commonplace, and the ways in which it did are more complicated questions. Nonetheless, the imagination of the southern hemisphere certainly inherited many of the earlier ideas of the antipodes.

The implications of European processes of ‘othering’, the specific application of this to imagination of the South Pacific, and the nature of settler colonial experience in Australia, both inhabiting and opposing this othered identity have all been described extensively elsewhere[109] but there are two points to be made here. Firstly, this is a particularly direct example of a concept relying on mathematical and astronomical science becoming thoroughly integrated within a social and political framework. Measurement of latitude, via observation of the altitude of known stars, was easily instrumentalized. That this instrumental knowledge should acquire such emotional resonance is not obvious. Secondly, the notion of hemispherical identity *was* keenly felt by a significant number of colonial migrants to Australia, and observation of the night sky was one of the most powerful ways in which this understanding was experienced.

This power is revealed by the accounts written by travellers in their shipboard diaries. The crossing of the equator was not just commonly recognised as a theoretical event, but as a lived experience. The global imagination that these travellers held was understood in

[109] Said, *Orientalism*, 2006; Arthur, ‘Antipodean Myths Transformed’, *History Compass*, 2007, 1862–1878; Veracini, ‘Historylessness: Australia as a Settler Colonial Collective’, *Postcolonial Studies*, 2007, 271–285.

emotional terms. The enormous distance that the migrants travelled held a power of its own, as did the extreme changes in climatic conditions experienced along the way.

> Among the thousands of immigrants who made the voyage from Britain to Australia, the sense of the earth's immensity conveyed by the sheer length of their passage may have been the most enduring mental legacy.[110]

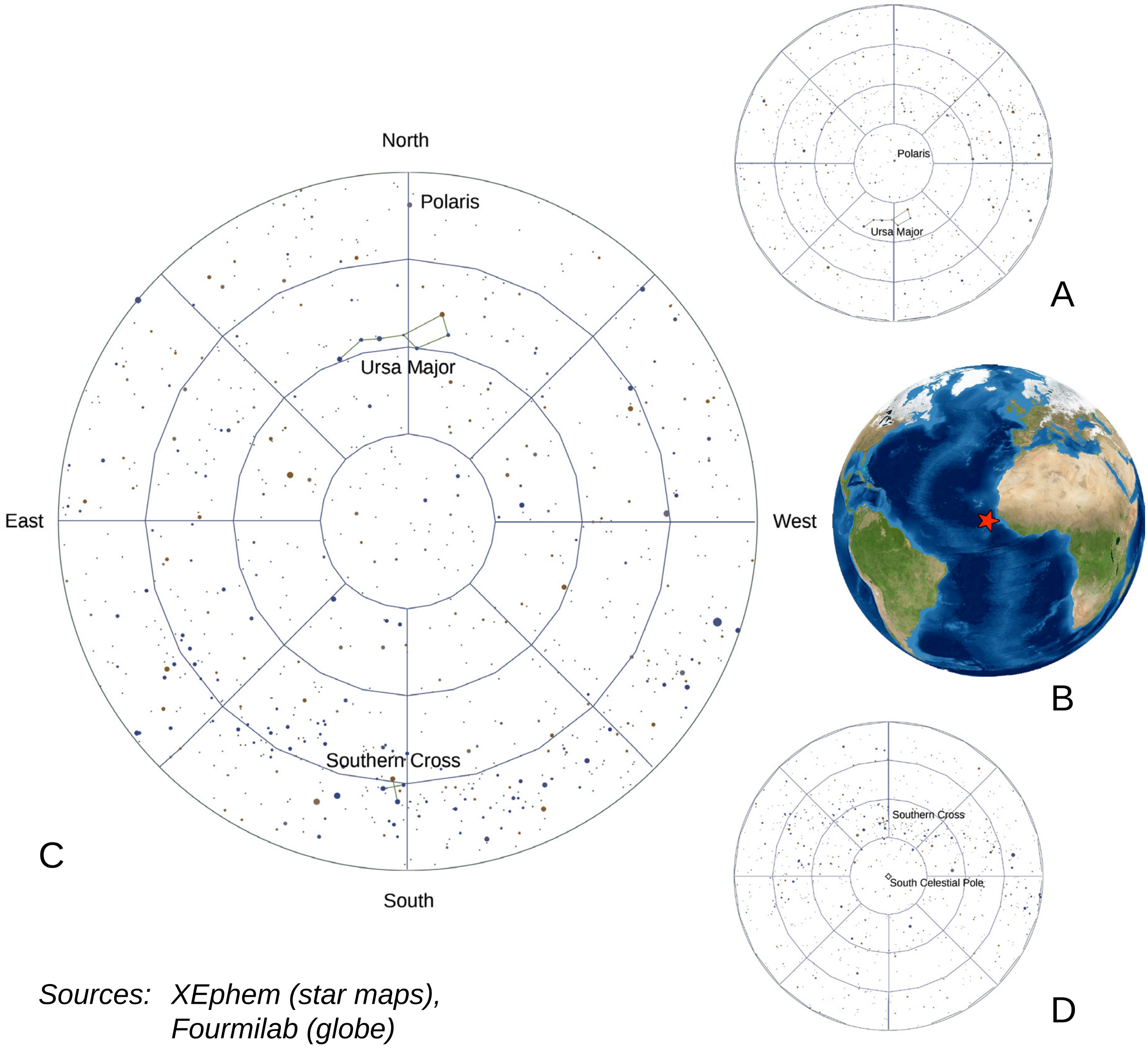
There was no experience that invoked this 'mental legacy' as much as the night sky.

Explicit examples of the way that hemispheres were experienced as a real identity are given by Mary Isabella Cameron—"As the time approached I felt rather sad at taking leave of the Northern Hemisphere"[111]—and by Elizabeth Row, 'crossing the line' in the other direction'—all of her companions were "pleased to be back in the northern hemisphere".[112] For these travellers, the identity invested in their conception of the hemispheres was real. As far as early colonists were concerned, Australia was placed in the 'other part of our globe'. One of the truest indications of this was the mark of the Southern Cross.

[110] Davison, *The Unforgiving Minute*, 1993, p. 49.

[111] Cameron, 'The Journal of Mary Isabella Cameron, 1847 on a Voyage from England to Tasmania on the Sailing Ship Tasmania'.

[112] Row, 'Elizabeth Barlow Row Journal of Journey on Star of Peace from Sydney to England, 27 April-3 August 1858', 1858.



Sources: XEphem (star maps), Fourmilab (globe)

In these star maps the large circle represents the horizon while the smaller circles show altitude above the horizon. The lines mark out directions around the horizon.

Figure 2.2 The Southern Cross and Ursa Major

The Southern Cross was paired with the northern constellation of Ursa Major by many travellers in the nineteenth century. As a consequence of this, sightings of the Southern Cross reminded many European migrants of the stars visible from ‘home’, creating a powerful emotional experience of memory. Both Ursa Major and the Southern Cross had bright stars and could be used to find directions or to tell the time of night.

At the North Pole only the stars of the northern hemisphere (A) can be seen. The converse is true at the South Pole (D). In-between, at least some stars from each hemisphere can be seen. The Right Ascension (the celestial equivalent of longitude) for the two constellations is similar, so from a region around 10° north of the equator (B), at the right times, both constellations can be seen in the sky, lying above opposite horizons (C). For those who saw this it no doubt emphasised their complementarity.

2.2.3 The identity of Europe as Christendom

Another aspect referred to by Dittmann is the symbolic power of the Southern Cross as a Christian symbol. This, according to Humboldt, was significant for Spanish and Portuguese sailors. The extent of religiosity in colonial Australian society has been somewhat contested, as will be further detailed in § 5.1. Certainly this Christian symbolism was intensely important for some, such as Melbourne doctor and politician Augustus Greeves, who will be discussed in § 2.2.7. For most, Christianity served as part of the cultural heritage of Europe, and thus provided an additional aspect to the notion of 'northern hemisphere' identity. Indeed, the idea of Europe as Christendom was one of the most long-standing collective identities ascribed to Europe.[113]

2.2.4 Cultural schema of astronomy: Australia as a land under the southern sky

However its significance is understood, it is clear that the Southern Cross *was* significant to nineteenth century travellers. The records that such travellers left in travel diaries attest to this. These diaries and similar sources will be considered in some detail; Figure 2.3 shows a selection of images from them. What is clearest from the many authors describing their experience of seeing the Cross is the power of memory, the connection of observation to 'the days that are gone' and the 'dearest affections' of home.

This strong emotional affect led to the strength of the association between Australia and the stars of the southern sky. Although the details of this association would change over the course of the nineteenth century its strength would persist, it would be shared between people and propagate over time, and it would continue to guide interpretations

[113] Pieterse, 'Fictions of Europe', *Race & Class*, 1991, 1–10.

of new events. The notion of Australia as the land under the Southern Cross would become a cultural schemata of astronomy.

One of the most poignant descriptions of the emotional pull of the stars comes from the German explorer Ludwig Leichhardt.[114] In north Queensland, in the early morning of 4 June 1845, Leichhardt roused his travelling companions to show them that they could now see the constellations of the northern sky.

> I shall never forget the intense pleasure I experienced, and that evinced by my companions, when I first called them, about 4 o'clock in the morning, to see Ursa Major. The starry heaven is one of those great features of nature, which enter unconsciously into the composition of our souls. The absence of the stars gives us painful longings, the nature of which we frequently do not understand, but which we call home sickness:— and their sudden re-appearance touches us like magic, and fills us with delight.[115]

Noted author Louisa Anne Meredith[116] also emphasizes the power of the stars; of all of the changes noticed on board ship she said "I do not know one thing I *felt* so much as the loss of the North Star".[117] For Meredith this emotional charge came from the explicit association of stars with memories of people.

> I thought of so many times and places associated in my mind with those bright stars; of those who had gazed on them beside me, some of whom had passed from earth, - and of the rest, who might say that we should ever meet again? Those stars seemed a last link uniting us, but it was soon broken - they sunk beneath the horizon[118]

[114] Erdos, 'Leichhardt, Friedrich Wilhelm Ludwig (1813–1848)'.

[115] Leichhardt, *Journal of an Overland Expedition in Australia*, 1847.

[116] O'Neill, 'Meredith, Louisa Ann (1812–1895)'.

[117] Meredith, *Notes and Sketches of New South Wales*, 1844.

[118] Ibid.

Nor was Meredith alone in making this connection. For Elizabeth Hentig “the aching delight with which we look upon the receding North Star & the dear old Bear” was because “with those bright stars I seem to hold communion with dear, dear beloved ones in Europe”;[119] the relationship between the stars of south and north was reinforced when she returned to Britain in 1864, and she could at last observe that the North Star “begins to look like it did of old”. In similar vein John Carre Riddell,[120] who would also serve in Victoria’s Legislative Council, and as President of the Melbourne Club in 1852 wrote “The lustre of the stars makes one quite sentimental. It is then that one thinks of home and all ones friends”.[121] Others, such as Cameron, would turn back to the northern skies and look at the stars that could be seen from both hemispheres: “The stars are beautiful, gazed at Orion for all your sakes Duckies”.[122]

Such references to the stars are extremely common. From more than a hundred consulted at archival repositories in Australia, thirty-eight travel diaries from migrants travelling from Britain to Australia for the first time in the period 1825 to 1850 were selected for close analysis.[123] Of these, around 40 per cent make reference to the night sky as a marker of the change of location on Earth. Table 2.1 contains the details of these manuscripts. Several of these diaries also contain images of the stars, as seen in Figure 2.3.

There are a number of factors that need to be considered in interpreting these diaries. In particular, the class bias to these archival sources is strong—almost all surviving manuscripts come from the wealthier cabin passengers, rather than the more numerous

[119] Hentig, ‘Elizabeth Hentig Journal of a Voyage from London to Sydney in the Thomas Arbuthnot, 1853 Followed by an Account of the Return Voyage from Sydney to London in the Maha Ranee, 1864’, 1853.

[120] McNicoll, ‘Riddell, John Carre (1809–1879)’.

[121] Riddell family, ‘Papers, 1841-1924’, 1841.

[122] Cameron, ‘The Journal of Mary Isabella Cameron, 1847 on a Voyage from England to Tasmania on the Sailing Ship Tasmania’.

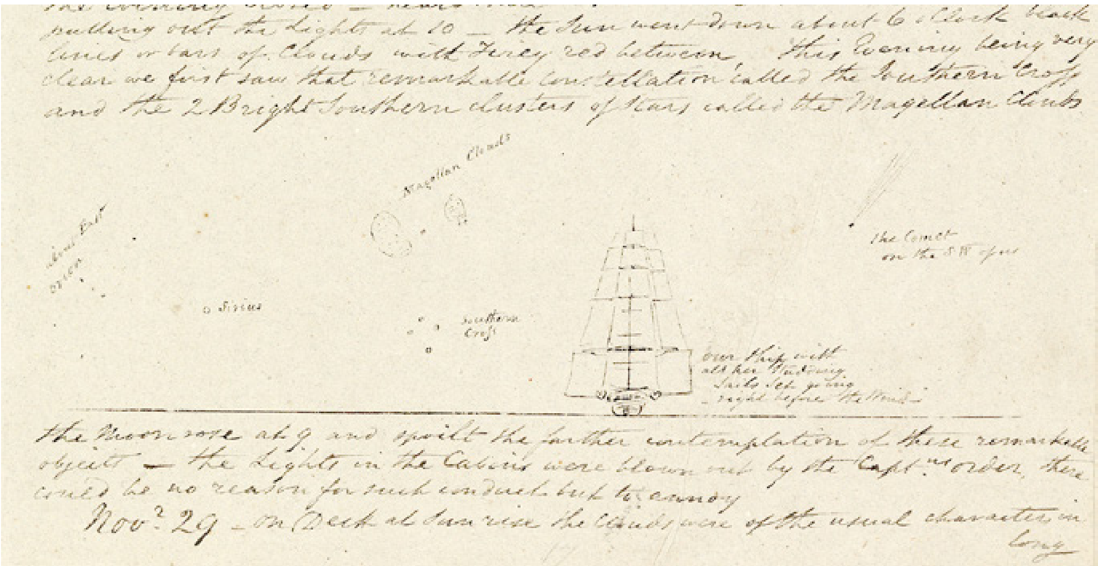
[123] Diaries were excluded from analysis if they were from ships’ officers or their relatives, from passengers who had already ‘crossed the line’, or were logs recording only information like temperature and location with little narrative. A small number of diaries were also excluded as illegible in sufficient parts to make analysis difficult.

but poorer steerage passengers. On the other hand, a simple diary count underestimates the number of passengers who observed the significance of the southern sky—some voyages were particularly cloudy, some passengers were distracted by sea-sickness or focussed their diary-writing entirely on personal matters, for instance. It is in any case clear that observing the changing appearance of the night sky over the course of the journey to Australia was commonplace. That two separate diaries from the same voyage (Peter Jones' and James Graham's) record the appearance of the Southern Cross on the same evening is suggestive that such observations were a matter of open discussion amongst at least some of the passengers and crew on a given voyage.

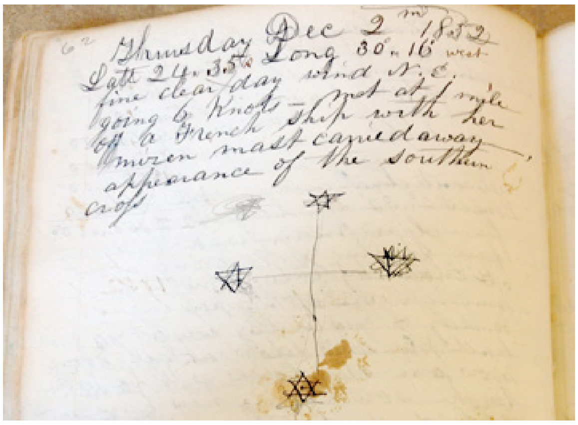
Essentially all migrants to Australia at this time had this experience of a gradual change in the night sky on board ship. That many, if not most of the early uses of astronomical symbolism in colonial Australian identity occurred in harbour and shipping contexts underlies the nautical basis of this tradition.

Over the rest of the nineteenth century this experiential basis would change. As described in § 2.1, by the beginning of the twentieth century, a majority of Australians had been born in Australia. The Southern Cross no longer reminded them of a distant home but rather was a symbol of their Australian home. Nonetheless, the relationship with Britain was still a major component of that. After noting its complementarity with the 'Great Bear', the writer for the *Australian Sketcher* would claim that the Southern Cross and "its brilliant stars and bright pointers, as they circle around the pole or hang low on the southern horizon, always attract the interest of all who begin to acquire a knowledge of the stars in this antipodal England".[124] (See Figure 2.4.) By 1880 the symbolism of the Southern Cross was still an important aspect of the global imagination of colonial Australians, but the nature of that symbolism had changed enormously over the course of a generation. These changes will be described in the following sections.

[124] 'Watching the Southern Cross', *Australasian Sketcher*, 20 Dec. 1879, p. 151.



Source: Tasmanian Archives and Heritage Office, NS 433



Source: State Library of Victoria, MS 11646

Figure 2.3 Shipboard drawings of the southern sky

Reports and drawings of the Southern Cross and other objects of the southern sky such as the Magellanic clouds are extremely common in diaries of travellers to Australia in the nineteenth century. The long passage by sea would have drawn attention to the stars as a marker for place. These diaries show that the night sky became powerful repository of memory and emotion, reminding travellers of distant homes, friends and family. This was the basis for the cultural schema of Australia as a land under the southern stars.

The larger drawing is from the diary of Henry Hellyer, the surveyor and architect, who travelled to Tasmania from Britain in 1825–26 on the ship *Cape Packet*.
The smaller drawing is from the diary of Thomas Pierson, who travelled to Melbourne from the USA in 1852 on the ship *Ascutna*.

Source: State Library of Victoria

Figure 2.4 ‘Watching the Southern Cross’, 1879

This is an Illustration from the *Australasian Sketcher* of 20 December 1879. The writer of the article accompanying this illustration suggested that the Southern Cross and the pointer stars “always attract the interest of all who begin to acquire a knowledge of the stars in this antipodal England”. The relationship between Australia and the United Kingdom was still being understood through the stars in the late nineteenth century, even as an increasing number of people grew up under the southern skies.

Nonetheless, throughout the late nineteenth century and into the twentieth, symbolism of the Southern Cross shifted towards an expression of Australian distinctiveness and away from signifying the relationship with Europe. Through this change the cultural schema of Australia as a land under the southern skies remained strong.

Table 2.1 References to southern stars in shipboard diaries, 1825–50

Diarist	**Year**	**Ship**	**Archive**	**Archive reference**	**Diary entries**
Henry Hellyer	1825	Cape Packet	ANMM	REF MS CAP 135733	28 Nov
Peregrine Langton Massingberd	1832/33	Edward Lombe	SLNSW	MLMSS 1644	No
William Hall Palmer	1835/36	Alice	SLNSW	MLMSS 5737	No
Daniel Adey Fowles	1836	(unknown)	SLNSW	MLMSS 7668	No
Tom Mort	1837	Superb	ANMM	REF MS SUP 141442	No
William Hamilton	1837	North Briton	SLV	MS 8960	7 Jul
James Stewart Johnston	1837	(unknown)	SLV	MS 7939	No
Francis Tuckfield	1837/38	Seppings	SLV	MS 11341	No
Angus McMillan	1837/38	Minerva	SLV	MS 9776	14 Sep
Peter Jones	1838	Alfred	ANMM	REF MS ALF 21461	8 Nov
James Graham	1838	Alfred	SLV	MS 8497	8 Nov
David Melville	1838/39	North Briton	ANMM	REF MS NOR 152993	No
Henry Watson	1838/39	Katherine Stewart Forbes	SLNSW	MLMSS 1161	20 Dec
John Carre Ridell	1839	Abberton	SLV	MS 10766	Y
William Postlethwaite	1839	Westminster	SLV	MS 10948	No
Robert Thompson	1839	Fergusson	SLV	MS 8627	No
Richard Ellis	1839/40	John	SLV	MS 9477/73	No
Mark Nicholson	1840	Duchess of Kent	SLV	MS 12285	21, 26 Mar
Richard Ryther Steer Bowker	1840/41	Georgiana	SLNSW	MLMSS 7548	No

Diarist	**Year**	**Ship**	**Archive**	**Archive reference**	**Diary entries**
Joseph Wilson	1841/42	Samuel Boddington	SLV	MS 12325	No
Susan Meade	1842	Caledonia	ANMM	REF MS CAL 147019	No
Henry Brinton	1843	Amiga	SLV	MS 7668; MS 7670	27 Mar
William Adeney	1843	Jane Frances	SLV	MS 8536	25, 29 Sept
Priscilla Raleigh	1843/44	Imam of Muscat	SLV	MS 12615	No
(unknown)	1844	Clarendon	SLV	MS 14082	18 Jun, 17 Aug
Charles Griffith	1844	Slains Castle	SLV	MS 9393	8 Aug
Andrew Mitchell Ramsay	1846/47	Anne Milne	SLV	MS 11021	No
Mary Isabella Cameron	1847/48	Tasmania	ANMM	REF MS TAS 147001	20, 25, 27 Nov, 14 Dec, 2 Jan
Robert Outhwaite	1847/48	Stag	SLV	MS 14029	Nov 13
George Wilcox	1848	Aden	ANMM	REF MS ADE 92199	No
Joseph Tivey	1848	Bermondsey	SLV	MS 8306	No
Helen Barber	1848	Sir Charles Forbes	SLV	MS 10850	No
James Trangmar	1848/49	Lord Hungerford	SLV	MS 8662	17 Dec
Joseph Adams	1848/49	Alice Maud	SLV	MS 13538	No
Edward Smale	1849	Hope	SLV	MS 13319	No
John Gibbins	1849	(unknown)	SLV	MS 13995	No
William Jackson	1849	Andromache	SLV	MS 10229	No
Thomas Turner áBeckett	1850/51	Andromache	SLV	MS 9035	No

ANMM: Australian National Maritime Museum SLNSW: State Library of New South Wales SLV: State Library of Victoria

2.2.5 The Southern Cross in Australian flags and arms

However the origins of the symbolic use of the Southern Cross is conceptualised, it is clear that it was featured prominently throughout colonial heraldry. One early use was its appearance in the Coat of Arms awarded to Bishop Broughton[125] for the Anglican Diocese of Australia in 1836. (See Figure 2.5.) The grant of arms specifically refers to the Southern Cross as "the principal constellation of the southern hemisphere",[126] yet another reference to the relationship to the northern hemisphere, European identity and Christianity.

The symbolic use of the Southern Cross that is easiest to trace over the course of the nineteenth century is its use on Australian flags. The Cross appeared on all of the major flags of Australia in the nineteenth century. There were three important designs that would continue, in slightly different forms, into the twentieth century. These designs were: the National Colonial Flag, which evolved into the New South Wales Ensign and then the Federation Flag; the Anti-Transportation League flag, a modified version of which was used as the Victorian colonial flag and another as the current Australian flag; and the Eureka flag. In all of these flags the use of the Southern Cross was a symbol of place on Earth, and particular relationships of Australian colonists to British imperialism and, more broadly, European culture.

[125] Cable, 'Broughton, William Grant (1788–1853)'.

[126] Johnstone and Johnstone, *The Book of St. Andrew's Cathedral, Sydney*, 1968.

Source: Low, Charles (1971) 'A Roll of Australian Arms', illustrated by Allan K. Chatto

Figure 2.5 Coat of Arms for the See of Australia

The Southern Cross became a symbol of Australia very quickly, appearing on local flags by the 1820s. The Cross was adopted for a range of reasons, including the near-ubiquitous experience of travellers seeing the constellation appear in the night sky as they travelled by ship to Australia.

This coat of arms, for the Anglican See of Australia, was awarded to William Broughton, the first Bishop of Australia, in 1836. The grant of these arms specifically refers to the Southern Cross as "the principal constellation of the southern hemisphere". This usage thus referred to both to Australia's place on the globe, and the idea of the colony as part of a European Christendom, two aspects of the symbolism of the that were important to many people at the time.

2.2.6 National Colonial Flag, or Federation Flag

The first known attempt to create a flag to signify the colony of New South Wales was the National Colonial Flag, designed by John Bingle[127] and John Nicholson as a flag for Sydney Harbour. (The Bowman Flag from 1806 predates the National Colonial Flag but was always intended as a private flag.)

A modified form of this flag went on to become the Federation Flag, the most popular flag of Australia at the end of the 19th century. Both versions of this flag featured the Union Jack in the canton (the upper inner corner of the flag), and a St George's cross across the centre, with four stars representing the Southern Cross set within the four arms of the cross. The differences between the two versions were that the National Colonial Flag featured a red cross, while the New South Wales Ensign, or Federation Flag, had a blue one. The latter flag also had a fifth star set at the centre of the cross, a device that was criticised by Bingle as 'disfiguring' the design by "not comprehending the original intention and embodying American notions".[128] Interestingly, the use of stars as symbolic, rather than as a representation of the Southern Cross, was seen as American.

The National Colonial Flag was widely used for shipping on the east coast of Australia from the 1830s, and so proved to be one of the most popular Australian flags, especially in New South Wales. This led to a certain amount of state-based rivalry over the choice of the Commonwealth flag in 1901. The Ensign was used by both the Australian Natives Association and the Australasian Federation League in their campaigns for federation. (See Figure 2.6.) Prime Minister Edmund Barton specifically included the Federation flag when submitting the proposed flag to the British Admiralty in 1901 and there had been support for this flag within his cabinet from ministers from New South Wales.[129] In 1908 there were still people who were unhappy that the Federation Flag had been passed over for the Commonwealth Flag as it was an "extremely beautiful flag" more worthy as "the national emblem of a great nation" than the "child's toy flag" that was chosen.[130]

127 Gray, 'Bingle, John (1796–1882)'.

128 Bingle, 'The Illustrated Retrospect of the Present Century', 1881.

129 Kwan, *Flag and Nation*, 2006, pp. 18–19.

130 Australian, 'The New South Wales Ensign', *Sydney Morning Herald*, 26 May 1908.

Source: Mitchell Library, State Library of New South Wales R 767

Figure 2.6 Badge with the Federation Flag, 1899

The Southern Cross appeared on all major flag designs of the nineteenth century, including the 'Federation Flag'. This was based on the earlier 'National Colonial Flag', differing through the inclusion of a fifth star at the centre of the St George's Cross.

Both versions of this flag were extremely popular, especially in New South Wales. The National Colonial Flag was commonly used for shipping along the east coast. The Federation Flag was adopted by several pro-Federation groups and was the preferred flag design of Australia's first Prime Minister, Edmund Barton.

This badge produced in support of Federation for the referendum in New South Wales in 1899 features the Federation Flag design.

2.2.7 Anti-transportation League Flag

The ‘toy’ flag that was chosen as the Commonwealth flag began as the flag of the Anti-Transportation League (also known as the Australasian League). (See Figure 2.7.) We have a few more details about the precise genesis of this flag. We know the name of the designer: John West, the Launceston based Congregationalist minister and prominent abolitionist activist, later editor of the *Sydney Morning Herald*.[131] On the other hand we are uncertain of the names of the women who made the first flag in 1851, a pattern that is echoed with the later Eureka flag.

The inspiration for the use of the Southern Cross in the design is also documented. It was due to a suggestion by Augustus Greeves,[132] the Melbourne doctor, Lord Mayor and colonial parliamentarian. Greeves, who like other leaders of the Anti-Transportation League was a Protestant, was explicit about the Christian symbolism. In speaking of the League’s difficulty in choosing an appropriate symbol, Greeves (who proposed the use of the Cross to West) told a meeting:

> In this dilemma, what did they do! They looked upwards to the heavens from whence they expected aid, and they took for their device their own beautiful constellation. The Southern Cross. This would always put them in mind of that other cross famous in history which the Emperor Constantine had seen in the heavens, and which had been the means of converting him to Christianity. From this it was that that Emperor had adopted his motto. “In hoc signo vinces" in this sign shalt thou conquer. Let them now adopt this motto, let them unite together and they would be successful. Let them rest their cause on the hearts and consciences of the whole people of Port Phillip, and on the right minded men of Van Diemen's Land, and of Sydney, and rallying under this banner they

[131] Reynolds, ‘West, John (1809–1873)’.

[132] Willis, ‘Greeves, Augustus Frederick (1805–1874)’.

> would find the success, that the first Christian emperor by the same blessed symbol, had experienced before them.[133]

The Christian allusions here are striking, especially with the reference to Constantine. While this is a more religious interpretation of the flag than usual, it is also the fullest expression of the Europe-as-Christendom tradition.

The symbolism of this flag was not exclusively religious. With a small amount of licence the position of the stars could represent the geographical relationship of the colonies with branches in the League: New South Wales, Victoria, Tasmania, South Australia. New Zealand could at least be represented as a pointer.[134] The League was unambiguously committed to confederation of the colonies, and the Southern Cross could also be deployed to this end.

The Anti-Transportation League was exclusively known as the Australasian League after the final abolition of transportation to the eastern Australian colonies in 1853. (Transportation of convicts continued to Western Australia until 1868.) Its flag was eventually adapted to become the Victorian colonial flag in 1870 and then would win out against its NSW-derived rival—the Federation flag—to provide the basic design of the flag chosen to represent the Commonwealth of Australia in 1901.

The Australasian League Flag also has the distinction of being the first Australian flag to fly outside Australasian waters; while the New South Wales Ensign was widely used as a local shipping flag on the East coast of Australia, the Australasian League flag was briefly flown by the *Mercury* in Mauritius in 1851 before the order was given by the Governor for it to be taken down.[135] The flag was also flown, more successfully, by the *Alert* in San Francisco on the occasion of the 76th Anniversary of US independence on 4 July 1852.[136]

---

[133] 'The Anti-Transportation League', *Argus*, 3 Feb. 1851, p. 4.

[134] 'New Colonial Flag', *South Australian Register*, 22 May 1851, p. 3.

[135] 'Local', *Cornwall Chronicle*, 24 Dec. 1851, p. 817.

[136] 'Flag of the Australasian League', *Launceston Examiner*, 6 Oct. 1852, p. 5.

Source: Collection of Queen Victoria Museum and Art Gallery, Launceston
Used with permission

Figure 2.7 Australasian League Flag, 1851

The flag of the Australasian League (originally the Anti-Transportation League) proved to be the most successful design of the nineteenth century. It was originally created in 1851 by Launceston minister John West on a suggestion by Melbourne doctor Augustus Greeves. The flag itself was made by unnamed women. This design went on, with some modifications, to be the Victorian colonial flag in 1870 and then, in 1901, was chosen as the flag of the Commonwealth of Australia.

The current flag of Australia is still based on this design, with the inclusion of a large seven-pointed 'Commonwealth Star' below the Union Jack, and other aspects of the proportions, placement and construction specified differently.

2.2.8 Eureka Flag

The Colonial flag originated and the Anti-transportation League flag continued in marine contexts amongst people who were almost entirely migrants to Australia. A significant development of the meaning attached to the Southern Cross came in a more terrestrial context with the creation of the Eureka flag as a symbol of the Ballarat Reform League and subsequently banner for the Eureka stockade. The flag was created in 1854 by women on the goldfields. The names of these women are not known for certain although there is an oral tradition that gives them as Anastasia Hayes, Anastasia Withers and Anne Duke.[137] The name of the designer of the flag was conventionally given as the Canadian miner 'Captain' Ross, although this attribution is also uncertain, based more on his leadership role in the hoisting of the flag rather than a direct claim. The basis of the design, too, is unknown. Various theories include the flag of Quebec, the latin cross of the Catholic priest at Eureka and the NSW Ensign as being sources of inspiration.[138] Figure 2.8 shows the remaining portion of the original Eureka Flag at the Museum of Australian Democracy at Eureka.

The extent to which the Eureka flag was intended as a symbol of independence is uncertain. The Ballarat Reform League explicitly considered advocacy for an independent Australia, separate from the English crown. Yet there were many opinions gathered under the banner: Chartists willing to assert the supremacy of popular sovereignty, non-British citizens with an ambivalent relationship to English law, and miners who saw themselves as merely defending the constitutional rights of Englishmen under the Crown. The Southern Cross, without a Union Jack, was an emblem they could all agree to. Whether the Eureka flag was flown with a Union Jack on the Sunday morning remains an open question in Australian history. Certainly the government saw the use of the flag as seditious. Thirty miners were tried for offences of treason, and the editor of the Ballarat Times for libel. The existence of the flag, construed by the prosecuting Attorney-General as a war flag, was often cited as evidence for the charges. In the trial of John Joseph the

[137] Wright, *The Forgotten Rebels of Eureka*, 2014.

[138] Ibid., pp. 381–83.

defending lawyer Henry Chapman asserted that the Southern Cross flag was, in fact, essentially the same as the Anti-Transportation League flag, which the Attorney-General himself had earlier acted under as an anti-transportation advocate:

> He could not affirm that it was the very identical piece of bunting displayed then, but it was a flag of the same character, for it was an emblem of the southern cross.[139]

This legal argument appears to have been a little mischievous—no one else ever suggested that the Eureka flag, with no Union Jack, was equivalent to the anti-transportation league flag, which featured the Union Jack prominently. Nonetheless the premise of Chapman's question underlined the connection between the use of the constellation and various ideas of Australian political identity. This connection would not just continue but would grow. Eureka was little discussed in public in the years immediately afterwards but it was never forgotten. Public sympathy was overwhelmingly on the side of the miners. The miners who faced court on the capital charge of treason were acquitted. A government-appointed inquiry recommended that almost all of the government's policies be abandoned. One of the miners' leaders Peter Lalor was not just elected to Parliament but became, in succession, chairman of committees, a minister and then Speaker in 1880; six years later Lalor's Eureka mate Duncan Gillies became Premier. By this time, the Eureka event was becoming more publicly celebrated. In 1884 the thirtieth anniversary induced more than a touch of nostalgia, and by 1904 Eureka and its flag were being invoked as symbols by the labour movement.[140] These associations with various political and social causes would only grow through the twentieth century, so that the Eureka flag and its Southern Cross remains an easily recognised device in Australia today.

[139] 'Supreme Court', *Argus*, 24 Feb. 1855, p. 5.

[140] Beggs-Sunter, 'Remembering Eureka', *Journal of Australian Studies*, 2001, 49–56.

Source: Art Gallery of Ballarat (Gift of the King family, 2001)
The flag of the Southern Cross (Eureka Flag), 1854, Unknown maker
wool & cotton, actual size 260.0 x 324.0cm (irreg.), original size 260.0 x 370.5cm (calculated)
Used with permission

Figure 2.8 Remnants of the Eureka Flag, 1854

The Eureka Flag, constructed on the Victorian goldfields in 1854, is one of the most iconic symbols of Australia despite never being an official colonial flag. It was marked by the absence of a Union Jack. Many British miners still understood the relationship of the Cross to the Jack and whether the Eureka flag was flown alongside a Union Jack remains an open question. Nonetheless, the absence of the Jack meant that Irish and American miners could swear by it. This inclusiveness was tempered—suppression of Chinese miners was one of the rallying cries of the Eureka movement.

The Eureka Flag marked the point in Australian history when the Southern Cross started symbolising Australian distinctiveness more than connection with Europe. The emotional power of the flag survives into the twenty-first century, carrying—separately—associations of nationalism and racism.

2.2.9 Conclusion for the Southern Cross in Australian flags

The Southern Cross in all of these flags was positioned in relation to the Union Jack, either by presence or absence, and thus its use invoked ideas about the relationship between the Australian colonies and the United Kingdom. The southern constellation was a marker of geographical difference the broader symbolisms within which it was expressed were of connection and continuity. This was emphasized explicitly in the motto for the University of Sydney suggested to go with its arms (featuring the Cross) by acting University Chancellor Francis Merewether: *Sidere mens eadem mutato*,[141] which may be loosely translated as "the stars change but the mind remains the same". The sentiment expressed by this motto was that the new Australian society was the British one of the southern hemisphere, a point explicitly made by the writer of the article associated with Figure 2.4. Yet this meaning was not fixed in time, or for all. By the early twentieth century, the Southern Cross was still a major symbol of Australian nationhood but could hold very different meanings. The flexibility of the Southern Cross as a device across this time period is shown by Figure 2.9 in which radical cartoonist Claude Marquet uses the Cross to criticise Australian militarism in the First World War. Separated by a period of sixty years, the same cultural trope could be used for explicitly pro- and anti-imperialist communications.

The link between the night sky and the place-making of the Australian colony—emerging from nautical practice and reinforced the ongoing experience of separation from home and family—was strong and persistent. This and the later experiences of settlers in Australia were shaped by global systems of trade and communication. The night sky became a powerful repository of the global imagination, the cultural schema of Australia as a land under the southern sky was a key device by which colonial Australians could make sense of their position on the world and their relationships with Europe.

[141] Barff, *A Short Historical Account of the University of Sydney*, 1902, p. 71.

Source: Wikipedia

Figure 2.9 ‘The New Southern Cross’, 1916

This image was produced by radical cartoonist Claude Marquet as part of the anti-conscription campaign in 1916. The Southern Cross once again serves as a symbol of Australian nationhood, but in this instance the woman in the foreground recoils at its militaristic nature. The wording at the bottom of the cartoon reads “The Southern Cross has always been looked upon by Australians as a symbol of peace and freedom, but a Yes vote will transform it into a token of slavery and strife. Vote No!”

The cultural schema of Australia as a land under the southern stars can be invoked even as notions of Australian identity are contested and the role of the symbol of the Southern Cross changes. This supports an understanding of cultural schemata as non-totalizing.

2.3 Timekeeping and placemaking: astronomical underpinnings of colonialism

The period of this thesis starts with the transition of colonial Australia to a settler colonial society from a penal one. By even the mid-nineteenth century the direct memory of convict experience was very low in most of the Australian colonies, and low everywhere. Nonetheless, the status of Australia as a former penal colony under military rule had significant institutional consequences: authoritarian rule persisted and self-government was delayed longer than may have been expected otherwise, and spending by a revenue-starved government on non-essential services was always parsimonious. Nonetheless, one scientific function that did receive at least some financial support was astronomy—and for good reason.

Astronomy was a foundational science for colonialism in general, and for a penal colony in particular. Colonisation required the control of resources at a global scale, the ability to send ships to a precise destination on the other side of the world. Astronomy provided the navigational practices to do this. Once landed, military operations—both to suppress the Indigenous Australian population and control the convict one—depended on the co-ordination of time. Davison notes that “doing time” as a synonym for imprisonment appears to have arisen in Australia. Surveying, too, was necessary for allocating the land seized by the colonial power. Again, astronomy was one of the sciences through which this was done. Surveying would remain a second institutional centre for astronomy, after government observatories, throughout the nineteenth century.[142]

[142] Orchiston, ‘Contribution of the Lands Department to the Development of Astronomy in New South Wales during the Nineteenth Century’, *Australian Journal of Astronomy*, 1987, 65–74.

It was the importance of astronomy for navigation that made it the first science to receive official government support in Britain. It was for similar reasons, to determine the precise latitude and longitude of the new colony in Sydney—as well as to look for a comet that Astronomer Royal Neville Maskelyn had calculated would return—that astronomer William Dawes[143] was sent to the penal colony with the first fleet. Dawes' astronomical work proved not to be as productive as he would like for various reasons: he had official duties as engineer and surveyor as well as astronomer; he had broad scientific interests that occupied him, including a study of the local Indigenous Eora people and their language; and most significantly, he had a strained relationship with Governor Arthur Phillip. Nonetheless Dawes did complete a preliminary measurement of the important longitude, which was repeated by Captain John Hunter and Lieutenant William Bradley.[144]

One reminder of the importance of astronomy to timekeeping in an era when accurate clocks were rare is the role that the Southern Cross played for many early colonists. This role as a celestial timekeeper was noted by Gustavus Dittmann in his Nautical Almanac article; it was also noted in Australia. By the 1840s, astronomical notes in newspapers would give the time of night of the vertical position of the Southern Cross to enable people to be able to estimate time.[145] The astronomer Carl Rümker[146] even developed a chart that detailed the calculations needed to tell the time of night from the Southern Cross and presented it to Eliza Darling, the wife of Governor Ralph Darling. (Figure 2.10)

The interrelated questions of precise determinations of longitude, synchronising ships' chronometers and establishing public time remained prominent in the public sphere throughout the nineteenth century. Indeed, the idea of public time underpinned as important an aspect of Australian history as the Eight Hour Day movement—without a

143 Mander-Jones, 'Dawes, William (1762–1836)'.

144 Morrison and Barko, 'Dagelet and Dawes', *Historical Records of Australian Science*, 2009, 1–40.

145 'Astronomical Notes for March', *Launceston Examiner*, 13 Mar. 1844, p. 3.

146 Bergman, 'Rümker, Christian Carl Ludwig (1788–1862)'.

strong culture of reliable public time, the basis for regulating an eight-hour workday is not present. "Ideas of measured time were at the very core of Australian working-class consciousness"[147] and according to Davison:

> This was not just because Australian working men were better able to realise the Eight Hours ideal, or because they placed a higher value on increased leisure than increased wages—though both were probably true—but because they had become so thoroughly imbued with a sense of clock time as a primary measure of value.[148]

Astronomy continued to retain an institutional connection with these ideas of public time.

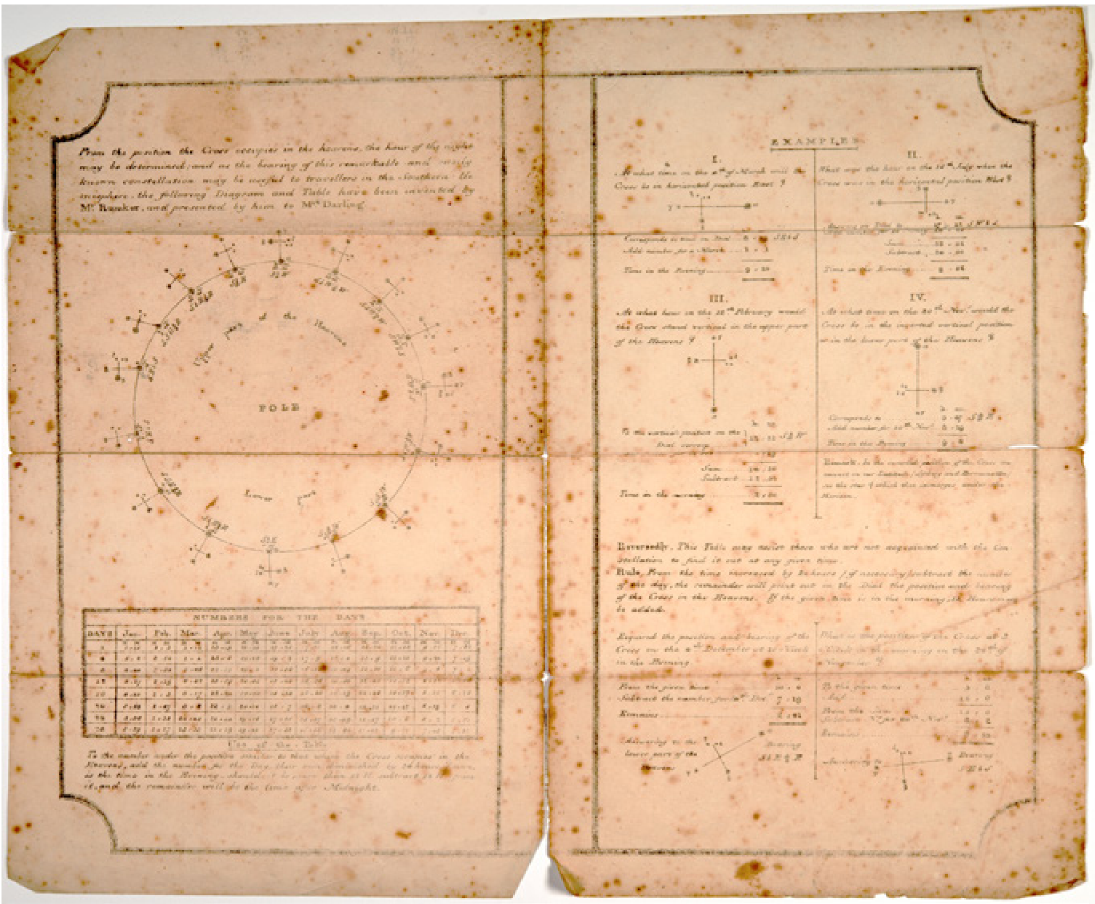
The important role for astronomy in governance did not automatically lead to an equally prominent place for astronomy in public consciousness. Nonetheless the institutional basis for astronomy in Australia as in Britain helped to keep the science in the public eye, and an emphasis on the practical applications of astronomy was particularly prominent in early popularizations, such as those of the Launceston harbourmaster Mathew Curling Friend.[149]

It is also the case that both the place-making described in the previous section and the institutional underpinnings described in this were relatively reflective associations. They were widely understood and the majority of the population had some direct experience of one or both. However astronomy impacted more immediately on daily life through other functions such as timekeeping, and as a suspected influence on the weather.

[147] Davison, *The Unforgiving Minute*, 1993, p. 92.

[148] Ibid., pp. 92–93.

[149] Cowie, 'Friend, Matthew Curling (1792–1871)'.



Source: Mitchell Library, State Library of New South Wales AR 51

Figure 2.10 Rümker chart for telling time from the Southern Cross, circa 1826

In the nineteenth century, in the era before accurate personal or public timepieces, there was considerable interest in using the Southern Cross to be able to tell time. The timekeeping, navigational and surveying applications of astronomy were foundational for the practices of colonialism; this use for the Cross reinforced associations between astronomy, science and practical matters in a more everyday context.

Astronomer Carl Stargard Rümker from the Parramatta Observatory made this chart for Eliza Darling, wife of the Governor Ralph Darling. The left-hand side gives instructions and the right-hand side examples of its use in telling the time. The chart is undated, but would have been produced in the late 1820s: Rümker was re-appointed to the Parramatta Observatory by Darling in 1826 and left the colony in 1829.

2.4 Weather, almanacs and daily associations with the sky

Some everyday associations of astronomy, which went beyond timekeeping and placemaking, did not concern the institutions of government at all. One of the most straightforward of these is the role of the Moon in providing night-time illumination in an era prior to artificial lighting.[150] Of even greater interest to colonial Australians, especially early in the period of this thesis, was the role of the sky in bringing weather.

One artefact for both of these concerns is the prevalence of almanacs in colonial society. Almanacs were one of the most popular and successful kinds of printed work in Britain from the late seventeenth to the early twentieth century and in Australia throughout the nineteenth century. Almanacs were a form of calendar listing significant dates, such as Easter. They also included astronomical information like sunrise and sunset times, the times of moonlight on different dates of moonlight and the appearances of the planets. Some almanacs claimed to predict the likely weather on any given day.

The different genres of almanac diversified beyond these core elements. The main feature of astrological almanacs was a weather prediction for every day of the year.[151] Clearly the experience of weather and understandings of climate were significant for colonial Australia. The weather—expected and unexpected—shaped much economic activity. In the nineteenth century more ‘rational’ almanacs such as the *British Almanac* started to

[150] Blainey, *Black Kettle and Full Moon*, 2004.

[151] Perkins, ‘An Era of Great Doubt to Some in Sydney’, *Journal of Religious History*, 1993, 465–74.

appear.[152] These almanacs supplemented their calendrical and astronomical information with lists of reference information as well as articles on serious subjects. Perkins suggests that the rational tradition predominated within colonial Australian almanacs although both were present.[153] Even *Moores' Australian Almanac*, named for the most iconic astrological almanac of all had shed its astrological elements by the second half of the nineteenth century and adopted the familiar directory listings, timetables, digests of statistics and other useful information.

2.4.1 Cultural schema of astronomy: The sky as a site of power

It is difficult to overstate the interest shown by the early colonial Australians in understanding the weather in Australia. The environment was unfamiliar yet coming to terms with it meant life or death for the isolated colonists. Few dangers were more threatening than bad weather, yet the seasonal patterns too were unfamiliar. Even worse, they were inverted from the sequence familiar from the northern hemisphere—just matching the seasons to months was a task that required attention, as shown in Figure 2.11. Many early publications for Australian colonists, including the *New South Wales Pocket Almanack* of George Howe, also gave advice on how to understand the correspondence between months and seasons.

Although astrological almanacs gained relatively little purchase in colonial Australia, weather almanacs had a substantial presence in the late nineteenth century. Figure 2.12 illustrates one such, *Clarson, Messina & Co.'s Weather Almanac. Baker's*; *Coleman's*; and *Langer's* are names of just some of the other weather almanacs produced in Australia in

152 Perkins, *Visions of the Future*, 1996, p. 23.

153 Perkins, 'Australian Almanacs', *Bulletin of the Bibliographical Society of Australia and New Zealand*, 1995, 219–30.

the latter half of the nineteenth century.[154] Some of these were evidently local publications, like *Letts' Weather Almanac*;[155] others, like the *Commonwealth Weather Chart* purported to give a forecast for all of Australia.[156]

In distinction to the astrological tradition, these weather almanacs were at pains to justify their long-range forecasts on an understanding of the physical influence of astronomical bodies on meteorological conditions, such as gravity, or magnetism as being "co-existent and co-extensive with gravitation".[157] The possibilities of physical influence between astronomical bodies and the weather was of considerable interest through the latter part of the nineteenth century. Newspaper reports and particularly letters to the editor record keen interest in systems of weather prediction based on astronomical cycles such as those of sunspots or lunar motions. Lieutenant Saxby from England, Dr Knapp from the USA and Professor Wiggins from Canada were three weather prophets who devised such systems. Each rose to public prominence at various times—Saxby in the 1860s, Knapp in the late 1870s and Wiggins in the 1880s.[158] Each faded from attention almost as quickly.

This succession of weather prophets deterred neither later ones from arising nor the public from taking interest in them. In the late 1880s the most prominent local weather prophet of the nineteenth century came to prominence in Sydney: Charles Egeson. Egeson was an assistant at the Sydney Observatory from 1884 until 1890. The first three years of his service appeared to be unremarkable but while the government astronomer Henry Chamberlain Russell[159] was overseas on a trip to Europe in 1887, Egeson started issuing weather forecasts to the *Evening News*. Upon his return, Russell ordered Egeson to

---

[154] 'Almanacs', *Examiner*, 8 Jan. 1861, p. 2; 'Local and General News. Almanac', *Northern Star*, 27 Dec. 1879, p. 2; 'Langer's Weather Almanac', *Newcastle Morning Herald and Miners' Advocate*, 4 Dec. 1886, p. 6.

[155] 'Local News', *Singleton Argus*, 3 Jan. 1894, p. 2.

[156] 'Commonwealth Weather Chart', *Australian Town and Country Journal*, 17 Oct. 1906, p. 13.

[157] Œdipus, 'Science. Scientific Gossip', *Leader*, 11 Dec. 1869, p. 5.

[158] 'Saxby's Weather System', *Age*, 1 Nov. 1864, p. 6; 'A Pestilential Period', *Queenslander*, 1 Feb. 1879, p. 148; 'Wiggins's Prediction', *Evening News*, 10 Mar. 1883, p. 5.

[159] Walsh, 'Russell, Henry Chamberlain (1836–1907)'.

stop producing them. Egeson initially complied, with Russell himself taking over the task of producing daily forecasts, but Egeson developed his system into a book, which was published in 1889.[160] When Egeson published another long-range forecast in the form of a letter to the *Evening News* in October 1889, Russell repudiated the forecasts as a product of the Observatory and Egeson was again ordered to stop. When he continued to make public pronouncements in 1890, he was charged with insubordination and eventually, in November 1890, dismissed from the Observatory.[161]

Egeson's system was based on a supposed correlation between the weather and sunspot cycles combined with details of the Earth's orbit. Using this system, in his 1889 supplement, he predicted that there would be flooding in May 1890 followed by three years of drought for New South Wales. Indeed there was heavy rainfall in May followed by a drier patch, but the predicted drought failed to materialise. The *Sydney Mail* reported that "Mr. Egeson's drought is, fortunately, still keeping its distance, and a fresh rainfall has just given a new start to the herbage";[162] the *Capricornian*, even more wryly, "Owing to the inclement state of the weather Egeson's drought has been postponed".[163]

Opinions about the merits of Egeson's work remained mixed. The *Leader* observed "Egeson's 'three years' drought' is now a standing joke in Sydney and other parts of the colony. The 'drought' has meant some months of almost incessant rain." Other writers to the papers also poured scorn on Egeson and his system.[164] This opinion was not universally shared; Egeson had more than a few defenders as well.[165] The *Worker* would

[160] 'Weather Prospects', *Sydney Morning Herald*, 28 Mar. 1889, p. 8; Egeson, *Egeson's Weather System of Sun-Spot Causality*, 1889.

[161] 'Mr. Egeson's Weather Forecast. The Official Correspondence', *Sydney Morning Herald*, 24 Oct. 1889, p. 4; 'Mr. Egeson's Weather Predictions', *Sydney Mail and New South Wales Advertiser*, 19 Oct. 1889, p. 854; 'Rival Astronomers', *Evening News*, 31 Oct. 1890, p. 6; 'Mr. Egeson's Late Position at the Observatory', *Sydney Morning Herald*, 29 Nov. 1890, p. 5.

[162] 'The Weather', *Sydney Mail and New South Wales Advertiser*, 24 Jan. 1891, p. 181.

[163] 'Barcaldine', *Capricornian*, 31 Jan. 1891, p. 28.

[164] eg 'Mr. Egeson Again', *Evening Journal*, 4 Feb. 1891, p. 3.

[165] eg 'Mr. Egeson's Predictions', *National Advocate*, 11 Mar. 1890, p. 3.

later consider that Egeson had been completely vindicated: his “cycle theories were laughed to scorn by the Jealous professional tribe at the time, but the ‘93 deluge swept Ridicule off its legs, and drowned it in the muddy waters of verification”. Still others occupied something of a middle ground, accepting of the principles of an astronomical connection with weather but sceptical as to Egeson’s particular system:

> it will be for scientific men to find out has the aphelion or perihelion of comets or planets or the apogee or perigee of the moon aught to do with these periods; or has the conjunction of the planets, and if not, what has? This is the true work for science to master.[166]

Astronomers and meteorologists were near-unanimous in rejecting Egeson’s system, as they had of earlier systems.[167] Robert Ellery of the Melbourne Observatory explicitly compared them with astrological predictions, “placed on a level with the predictions of the Old Moore or Zadkiel Almanacs, which were so thoroughly believed in by the grandfathers and grandmothers of the present generation”. Clement Wragge, the Meteorological Observer of Queensland, whose own reputation would encompass both professional meteorologist and weather prophet, was considerably gentler, though also sceptical.[168] While thinking Egeson’s forecasts to be unwise, he stated “solar activity must influence either positively or negatively to a certain extent the atmospheric condition of this earth”.[169]

Russell’s position was even more interesting. Although Egeson’s chief antagonist in this particular conflict, Russell himself was not averse to speculating about astronomical influences on weather. He had by this time already claimed that “there are several causes outside our earth producing atmospheric effects” and he would go on to develop a theory

[166] ‘Mr Egeson’s Prophecy’, *Freeman’s Journal*, 15 Mar. 1890, p. 7.

[167] Saxby, *Saxby’s Weather System: Or, Lunar Influence on Weather*, 1864, p. 18.

[168] ‘Weather Prophets. Wragge on Egeson’, *Burra Record*, 23 Dec. 1890, p. 3.

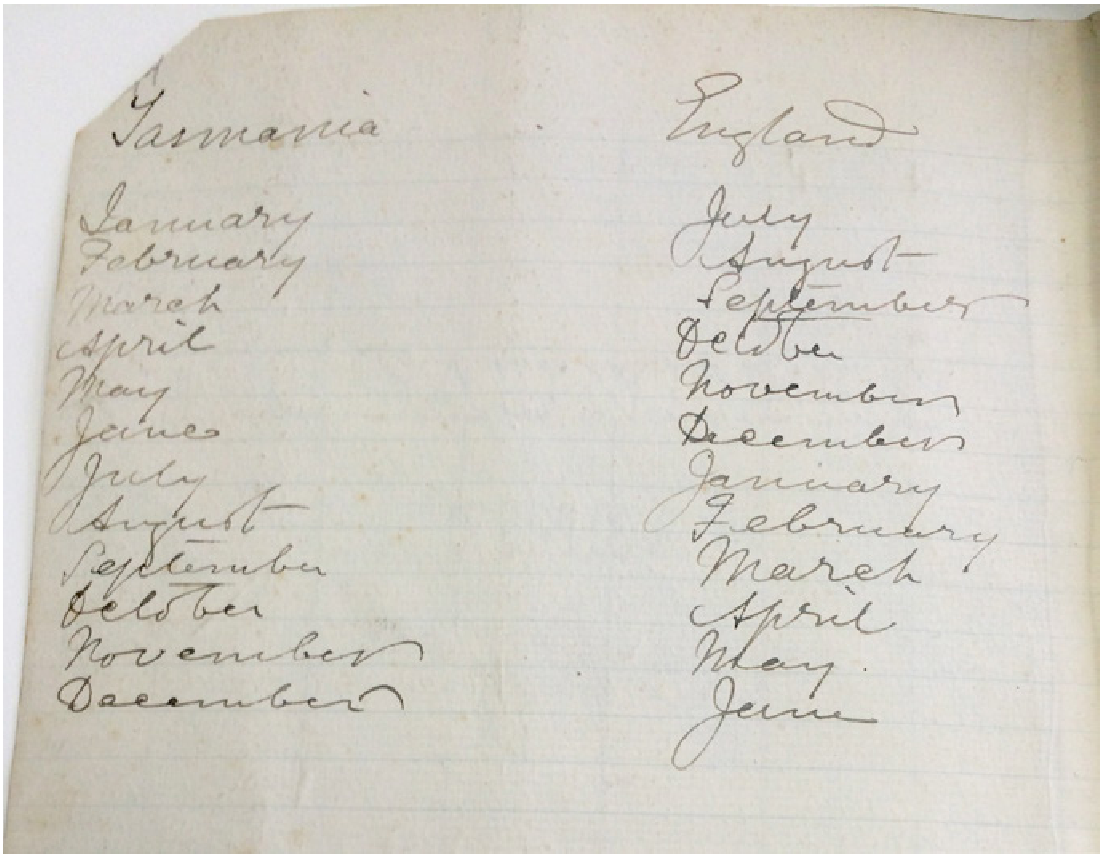
[169] ‘The Meteorology of Australasia’, *South Australian Register*, 2 Jan. 1891, p. 7.

about the connection between the Moon and rainfall.[170] As a consequence, Russell would himself be sometimes associated with the ‘weather prophets’, especially his erstwhile employee Egeson. (See Figure 2.13.)

Knowledge of Egeson and his predictions were widespread across Australia, and opinions were divided. Well into the twentieth century Harcourt Giddons and Inigo Jones—a protégé of Wragge’s—would continue the tradition of long-range forecasting. The interest in weather forecasting as a matter of importance was intense and the desire to bring order into the chaos was palpable. The cultural schema of astronomy as an exemplary science of perfect order—to be described in § 2.6.3—spoke to the latter concern while the cultural schema of astronomy as telling of a sky that is a site of power and danger underlined the former one

The weather was not the only way these connections would be expressed. Popular astronomy, too, made this connection with its cultural schemata in ways that will be described in § 2.5.1 and § 3.6.1. The two sciences of the sky were connected in this way and the association was mutually reinforcing. This connections were experienced in many parts of the world but they were particularly acute for immigrants in the unfamiliar Australian environment and under new stars.

170 ‘Influence of the Moon on Rainfall’, *Sydney Mail and New South Wales Advertiser*, 21 Sep. 1901, p. 728.



Source: University of Tasmania Library Special Collections

Figure 2.11 Francis Abbott’s chart showing correspondence of months

Understanding the weather patterns of Australia was vital for colonists. However those patterns could be difficult for many new arrivals. Even understanding the seasonal reversal in the southern hemisphere could be a challenge.

This chart from a notebook of Francis Abbott, the Tasmanian amateur astronomer, shows his attempt to match the seasons in Britain with those in Tasmania. Many early colonial publications and guides for new colonists contain similar descriptions.

WEATHER TABLE.

(By Dr. Herschel, of London.) Note.—The weather opposite dates in the Calendar is calculated upon this Table, which has been found, by careful observations at Sydney, to be equally applicable to the Southern as to the Northern Hemisphere.

When the Moon changes.	In Summer you may expect.	In Winter you may expect.
Between the hours of 12 o'clock noon and 1 p.m.	Much Rain	Snow and Rain.
Between 2 and 4 p.m. ..	Changeable	Fair and mild.
" 4 and 6	Fair	Fair.
" 6 and 10	Fair if the Wind blows from E. or S.E. Rain if N. or N.E.	Fair and frosty if the wind be S. or S.W. Rain, if the wind be N. or N.E.
" 10 and 12 night..	Fair	Fair and frost.
" 12 and 2 morn. ..	Fair	Frost, unless wind be N. or N.E. Rain.
" 2 and 4 " ..	Cold and Showers.. ..	Snow and stormy.
" 4 and 6 " ..	Rainy	Snow, rain, and stormy.
" 6 and 8 " ..	Gusty wind and rain ..	Stormy weather.
" 8 and 10 " ..	Changeable	Rain if wind E. snow if W.
" 10 and 12 " ..	Showers	Cold and windy.

1st Month. JANUARY. 31 Days.

New Moon..........Sunday, 2nd, 9 45 a.m.
First Quarter ......Monday, 10th, 6 42 a.m.
Full Moon ....Tuesday, 18th, 12 35 a.m.
Last Quarter ......Monday, 24th. 8 3 p.m.
Apogee—9th, 10 a.m. Perigee—21st, at midnight.

Day of Mn.	Day of Wk.	Remarkable Events.	Probable Weather.	Sun Rises H.	M.	Sun Sets H.	M.	Moon's Age D.	Moon H.	M.
1	Sat	Yan Yean Water-works opened, 1858		4	43	7	24	29	R. 3	47 a.m.
2	S	● 2nd Sun. aft. Christmas	Changeable, with partial showers.	4	44	7	24	0	S. 7	37 p.m.
3	Mo	Bank of Victoria opened, 1853		4	45	7	24	1	8	27
4	Tu	Westernport disc. by Bass, 1798		4	46	7	24	2	9	11
5	We	N.S.W. Constitution proc. 1843	Fresh b.	4	47	7	24	3	9	49
6	Th	Epiphany.		4	47	7	24	4	10	22
7	Fri	First Maori War, 1845		4	48	7	24	5	10	52
8	Sat	First V.D.L. newspaper, 1810	Strong b.	4	49	7	24	6	11	20
9	S	1st Sun, after Epiphany.		4	50	7	23	7	11	47
10	Mo	☽ Penny Postage established, 1843	Gusty, with wind and rain.	4	51	7	23	8	—	—
11	Tu	Registration Bill pas. Victoria, 1853		4	52	7	23	9	12	14 a.m.
12	We	First British Parliament, 1205		4	53	7	23	10	12	44
13	Th	First transports arr. Bot. B. 1788		4	54	7	23	11	1	14
14	Fri	Earthquake in Sydney, 1801	Light b.	4	55	7	22	12	1	49
15	Sat	La Trobe, 1st Gov. Victoria, 1851		4	56	7	22	13	2	30

Source: State Library of Victoria RARELT 824 V66 (v.131)

Figure 2.12 Extracts from *Clarson, Messina & Co.'s Weather Almanac* for 1870

Australian almanacs are considered to have been based in the 'rational' tradition, with relatively few astrological almanacs in circulation in the nineteenth century relative to the situation in Great Britain. However weather almanacs, like *Clarson, Messina & Co.'s*, which contained long-range weather forecasts for a whole year, were somewhat popular.

In contrast to astrological almanacs, most Australian weather almanacs attempted to base their system for forecasting on scientific grounds such as the influence of astronomical bodies on the weather. However many meteorologists of the time disputed those systems. *Clarson's* was supposedly based on the work of "Dr Herschel, of London", calibrated with "careful observations at Sydney".

Source: State Library of Victoria

Figure 2.13 ‘Weather Prophets’, 1890

This cartoon, published in the *Bulletin* of 29 March 1890, depicts Henry Chamberlain Russell, astronomer at the Sydney Observatory, and one of his assistants Charles Egeson. Egeson, who had worked at the Observatory for six years, was author of ‘Egeson’s Weather System’ and a popular ‘weather prophet’. The back of Egeson’s coat has a picture of a barometer labeled “Egeson’s Patent” and the men are also holding coils as in a barometer. In fact by this time the relationship between the two had broken down, not least because of Egeson’s public forecasts. Egeson would be dismissed from the Observatory staff later in 1890, but continued to issue forecasts. Russell, too, would continue to speculate in public about the influence of the Moon on weather. Despite the scepticism of most meteorologists, the association between astronomy and the weather would continue to stimulate attempts at long-range weather forecasts.

2.5 Public astronomical events

A particular feature of the practice of astronomy is the extent to which it includes events as public displays; few other phenomena are as visible to all as those of the sky. These public astronomical events include cometary appearances, eclipses of the sun or moon, and bright meteors or meteor showers. (See Figure 2.14.) All of these kinds of events occurred in the skies above Australia in the mid-nineteenth century. The public response to them gives a strong indication of the role of astronomy in culture. In particular, observations of comets over southern skies both created recognition for colonial science abroad, and contributed to the formation of Australian identity at home.

The public experience of these events lies in their ability to be observed by people without any particular equipment. Indeed the most spectacular of them are difficult to miss: the sudden dimming of bright sunlight in a cloudless sky will draw the attention of many otherwise unwitting observers, as described at Goulburn and at Kilmore in 1851.[171] This status of astronomy as both directly accessible to public observation yet involving complex abstract calculation, with objects of study that are part of the everyday world yet remote and untouchable, of involving both repeatable and spectacular appearances, is one aspect of the cultural schema that astronomy is an exemplary science.

The predictability of at least some of these public astronomical events—especially eclipses, but to a lesser extent some comets and meteor showers—enhanced their public nature. The prophetic nature of the predictions was certainly remarkable to many while the forewarning gave time to build a public discussion.

[171] ‘Kilmore’, *Geelong Advertiser*, 6 Feb. 1851, p. 2; ‘Goulburn’, *Sydney Morning Herald*, 14 Feb. 1851, p. 2.

Source: State Library of Victoria H16486

Figure 2.14 Illustration of a meteor by Becker, 1860

Ludwig Becker, German naturalist, made this watercolour image of a meteor near the Darling River on 11 October 1860, while on the Victorian Exploring Expedition led by Robert O'Hara Burke. Becker would lose his life on the expedition in April 1861.

The practice of astronomy is distinguished by the extent to which lay observers with no special equipment are able to participate in the observation of phenomena. This reinforces the association of the visual science of astronomy with visualization. The nature of the night skies as being part of the everyday world, yet the objects of astronomy remote and untouchable is one of the features that makes astronomy distinctive.

2.5.1 Comets

Comets were of particular fascination throughout much of the nineteenth century. In the eighteenth century it had been established to astronomical satisfaction that comets were celestial bodies obeying Newtonian motion; the predicted reappearance of Halley's comet in 1758–59 as predicted cleared any lingering traces of doubt about this. By the time of Halley's next return this understanding was widely spread. The change in understanding about comets was remarkably quick: within one generation comets had gone from being almost entirely mysterious objects to just another member of a regular solar system and within the next, spectroscopic techniques would describe even their composition. That cultural perceptions of comets were much slower to change—and that popularization continued to speak to both aspects—will be a main point of the section and one of the major justifications for adopting an analytical framework of cultural schemata.

As well as the broader cultural ramifications, the development of the orbital mathematics for comets provided a focus for amateurs to be involved. Techniques for computing cometary orbits from limited observations, initially developed by Gauss at the start of the nineteenth century and then refined by Encke to the point they could be published in Cyclopaedias by the 1820s,[172] brought the task within the capabilities of many. Observations of new comets was also a point of interest. As well, the early decades of the nineteenth century saw a number of bright comets appear and new short-period comets discovered, while later in the century John Tebbutt,[173] who would become the pre-eminent Australian astronomer of his era,[174] rose to prominence through his discovery of the Great Comet of 1861.

[172] 'Comet', 1819, 120–40.

[173] Wood, 'Tebbutt, John (1834–1916)'.

[174] Orchiston, 'John Tebbutt and Observational Astronomy at Windsor Observatory', *Journal of the British Astronomical Association*, 2004, 141–54.

In Australia, comets were first observed by British colonists in the 1820s.[175] Indeed, the finding of Encke's comet on its 1822 reappearance by Rümker at the Parramatta Observatory was one of the first scientific acts in the colonies that was noted by the European centre. A second comet was also seen in 1822, and then further comets in 1823, 1824, 1825, 1833 and 1834.[176] However Australian interest in comets really took off in 1843 with the appearance of a comet first appearing in a southerly location. On 27th February a comet was observed in the evening sky, close to the Sun. Over the next few days as it moved away from the Sun it grew and brightened considerably. At its peak it was bright enough to be observed during the day and its tail stretched third of the way across the sky.[177] Needless to say, such an apparition was widely noted. There are descriptions of this comet in published memoirs,[178] records of this comet in extant diaries[179] and several drawings of it survive.[180] Figure 2.15 show three of these images, including one by Mary Allport, which later appeared in the *Illustrated London News*. The Great Comet of 1843 was also the subject of reports, poems and hundreds of letters to the editors in newspapers around the country. Amongst other legacies in the popular imagination was the naming of a Sydney ferry *Comet*.[181] (A 'Great Comet' is one that is visible even in daytime; the nineteenth century saw eight great comets—a relatively large number. By contrast there have only been four great comets in the past 100 years.)

Australian colonial society was highly attuned to the colonial relationship between Australia and a distant Britain that lay in the opposite hemisphere but which remained home for many. That colonials understood that the relationship could be seen in the sky overhead was described in § 2.2. They were aware that the comet was not initially visible

[175] Saunders, 'Sir Thomas Brisbane's Legacy to Colonial Science', *Historical Records of Australian Science*, 2004, 177–209.

[176] 'Comets in Australia', *Australian Town and Country Journal*, 21 Feb. 1880, p. 25.

[177] 'The Comet', *Geelong Advertiser*, 6 Mar. 1843, p. 2.

[178] Meredith, *My Home in Tasmania*, 1852.

[179] Boswell, *Annabella Boswell's Journal*, 1981.

[180] Synnot, *Sketch of a Comet*, 1843; Allport, *Comet of 1843*, 1843.

[181] 'The Steamer Comet', *Sydney Morning Herald*, 12 Apr. 1843, p. 2.

in Europe (although its motion quickly made it so). The comet was referred to as the 'Australian Comet' in a number of newspapers, particularly the *South Australian Register*,[182] thus providing another example of Australian identity being expressed through its relationship to the southern hemisphere sky.

One aspect of the public discussion of comets highlights the nature of science as an amateur practice. In an era when science was still based around the 'local scientific gentleman', and in which self-education was highly valued, comets were able to become the sites of contest over intellectual skills. This is revealed by the existence of a number of disputes conducted in the letters pages of the newspapers. The 1843 comet prompted such disputes in the *Colonial Times* of Hobart (between 'M.' and 'J.G.')[183] and the *Southern Australian* of Adelaide (between A.J.M. and 'A Lover of Science')[184]. Two years later, even William Branwhite Clark,[185] one of the major figures in Australian colonial science at the time was drawn into such a dispute in the pages of the *Maitland Mercury* with Bourn Russell (whose son Henry would go one to be NSW Government Astronomer).[186] These disputes concerned various matters. M. and J.G.'s dispute was over the direction the tail went, its visibility in the northern hemisphere and the nature of comets; A.J.M and A Lover of Science's was about when the comet reached perihelion and its appearance on first sighting; Russell and Clark's concerned a reconstruction of the comet's orbit and the correct nomenclature concerning the comet's tail.

---

[182] 'The Australian Comet', *South Australian Register*, 12 Apr. 1843, p. 3.

[183] 'The Comet', *Colonial Times*, 11 Apr. 1843, p. 3; 'To the Editor of the Colonial Times', *Colonial Times*, 25 Apr. 1843, p. 3.

[184] 'The Comet', *Southern Australian*, 10 Mar. 1843, p. 2; 'To the Editor of the Southern Australian', *Southern Australian*, 10 Mar. 1843, p. 2; 'To the Editor of the Southern Australian', *Southern Australian*, 21 Apr. 1843, p. 3; 'To the Editor of the Southern Australian', *Southern Australian*, 17 Mar. 1843, pp. 2–3; 'The Comet', *Southern Australian*, 24 Mar. 1843, pp. 2–3; 'The Comet', *Southern Australian*, 28 Apr. 1843, pp. 2–3.

[185] Mozley, 'Clarke, William Branwhite (1798–1878)'.

[186] 'The Comet', *Maitland Mercury and Hunter River General Advertiser*, 8 Feb. 1845, p. 1; 'The Comet', *Maitland Mercury and Hunter River General Advertiser*, 18 Jan. 1845, pp. 2–3; 'The Comet', *Maitland Mercury and Hunter River General Advertiser*, 22 Feb. 1845, pp. 2–3.

A number of factors can be seen behind these disputes. Most obviously they indicate the presence of a community of interest in the subject of the comet. The precise matters of dispute are also revealing. Although the letters do contain speculative interpretations these do not tend to become matters of dispute. Instead the arguments centre on questions of personal observation of the comet and by implication individual prowess over astronomical calculation; Wahl-Jorgensen has characterised this kind of writers' motivation as Exhibitionist.[187] By the early nineteenth century the calculation of a comet's orbit—a near intractable problem a century earlier—has been reduced to a technique that is published in encyclopaedias and is amenable to anyone with a moderately good mathematical education. Comet observation and calculation remains within the province of the scientific amateur. The public disputes suggest that this status is socially desirable within some sections of the community.

A more long-standing aspect of the public discussion of comets was their association with premonitions of disaster. Some of the cultural schemata associated with comets throughout the nineteenth century—including with that that of 1843—are clearly revealed by the prevalence with which these superstitions are cited in reports. Almost without exception such citations are used as evidence of the superiority of modern scientific attitudes; references to "these enlightened times"[188] or equivalent in these reports is common. Other, less civilized nations, and less educated members of colonial society were frequently identified as holding such fears and superstitions, although as late as 1910 it was noted in the *Wagga Wagga Advertiser* that "white people, under pressure of the same primitive emotions which stirred the ignorant savages at sight of the wanderer through space, gave vent to their feelings".[189] Papers such as the *Illustrated Sydney News*, the *Evening News* and the *Empire* had earlier gently mocked people who had been worried by

[187] Wahl-Jorgensen, 'Letters to the Editor as a Forum for Public Deliberation', *Critical Studies in Media Communication*, 2001, 303–20.

[188] 'Peters' Comet', *Darling Downs Gazette and General Advertiser*, 25 Mar. 1865, p. 3.

[189] 'Fear of The Comet', *Wagga Wagga Advertiser*, 24 May 1910, p. 2.

the appearance of a comet in 1872[190] and the prediction that the Earth might collide with it, or pass through its tail:

> In these days of scientific investigations and discoveries; of astronomical lectures and debates in Mechanics' Institutes, it might hardly have been credited that the predicted advent of this "destroying angel" had caused quite a panic in some quarters, and considerable uneasiness amongst some persons not quite so timid. Yet it is so; and although, since the announcement of the coming fiery visitor was made, many re-assuring statements have appeared in the Press, there is reason to believe that no small amount of uncertainty prevailed amongst a few up to Monday night.[191]

Interest in comets displays a particularly rich complex of associations: the positive value of modern science, astronomy as an exemplary science and science situated within a series of social and racial hierarchies. Above all, the schema of the sky as a site of power and danger is very strongly evident.

This schema was one that was widespread in European thought. The continued interplay of rational discourses about comets with the older, superstitious ones throughout the eighteenth century has been studied in detail by Schechner.[192] The reports quoted in this section show that the association of comets with fortune—and misfortune—continues throughout the nineteenth century, despite explicit disavowals of superstition, and attestations of a scientific attitude. A concern early in the century is the connection of comets with the weather; by mid-century the concerns about the likelihood, and effects of a direct impact with Earth are more prominent. A variation on this theme, concerning the

[190] 'The Month', *Illustrated Sydney News and New South Wales Agriculturalist and Grazier*, 31 Aug. 1872, p. 2; '(No Title)', *Evening News*, 12 Aug. 1872, p. 2; 'The Expected Comet', *Empire*, 14 Aug. 1872, p. 4.

[191] '(No Title)', *Evening News*, 12 Aug. 1872, p. 2; See also 'The Month', *Illustrated Sydney News*, 31 Aug. 1872, p. 2.

[192] Schechner, *Comets, Popular Culture, and the Birth of Modern Cosmology*, 1999.

potentially apocalyptic effects of a cometary collision with the Sun was developed by Richard Proctor in the 1870s and 80s, in a way that will be detailed in § 3.6.1.

A major development in thinking about comets came with Huggins' and Draper's spectroscopic observations in 1881. These revealed—in the comet discovered by John Tebbutt—the presence of cyanogen, a toxic gaseous form of the cyanide group.[193]

This application of spectroscopy to astronomy, allowing the chemical composition of far distant objects to be determined, was one of the greatest advances in nineteenth century astronomy and is commonly described as the origin of the whole branch of astrophysics, that is the study of the physical nature of astronomical bodies. Beyond this scientific importance, spectroscopy loomed large in popular consciousness as an example of scientific progress.

This existence of poisonous gases in the bodies of comets was taken up by the French astronomer Camille Flammarion. Unrivalled as a popularizer in the Francophone world, Flammarion was scarcely less influential amongst Anglophones. Interested in astronomy from a young age, Flammarion was impoverished at age 14 when his parents suffered a financial disaster. He obtained a position as an assistant at the Paris Observatory, but success came in 1861 with his first book, *La pluralité des Mondes Habités*, on the possibility of life on other worlds. His 1880 work *Astronomie populaire* was a bestseller and secured his reputation. In 1883 he was gifted a private observatory by a wealthy admirer, and there he pursued not just his astronomy but his growing interest in spiritualism: "the observatory was dedicated like a temple"[194] to both interests.

Flammarion's pronouncements, reported around the world, became increasingly dramatic. He was already willing to consider the long-term history of the Earth and its apocalyptic consequences for the human race in *Astronomie Populaire*. (See Figure 2.16.) This interest reached a pinnacle with his eschatological essay-novel, *Omega: The Last Days of the*

[193] Russell, 'Comet B, 1881', *Sydney Morning Herald*, 11 Oct. 1881, p. 3.

[194] Baum, 'Flammarion, Nicolas Camille', 2014, pp. 727–729.

World. Published in 1893 it was translated into English in the following year and serialised in the *Cosmopolitan* magazine, with extracts appearing in Australian papers.[195] Appreciated in its day, it "exercised a powerful influence on a great many visionary novelists, including Jules Verne and H. G. Wells". [196] Verne would specifically reference Flammarion as an expert on comets in his book *Hector Servadac*; in 1876 Flammarion would list Verne as one of the authors who owed him a debt.[197] Although Wells never explicitly credited Flammarion, historians of science fiction have noted how his short story "The Star", later reworked as *In the Days of the Comet*, appeared immediately following *Omega*, and shared many details with it.[198] An examination of *Omega* provides a good instantiation of Broks' dictum within this thesis.

The novel itself was a fictional account, yet clearly intended to convey serious ideas. The first half foreshadows the end of the world through a cometary impact.

> Carbonic-oxide! Nothing else was talked of. The spectroscope could not be in error. Its methods were too sure, its processes too precise. Everybody knew that the smallest admixture of this gas with the air we breathe meant a speedy death.[199]

As the comet approaches and fills the skies, the "Australian cities of Melbourne, Sidney [sic] and Pax"[200] prove to be a refuge for the wealthy of Europe. For the masses, the forecasts of the astronomers proved accurate:

[195] 'The Last Days of the World', *Geelong Advertiser*, 9 Sep. 1893, p. 2.

[196] Silverberg, 'Introduction', 1999, pp. v–xi (p. v).

[197] Verne, *Off on a Comet: Or, Hector Servadac*, 2009, p. 402; Flammarion, *Les Mondes Imaginaires et Les Mondes Réels: Voyage Pitoresques Dans Le Ciel*, 1876, p. 575.

[198] Aldiss and Wingrove, *Trillion Year Spree: The History of Science Fiction*, 1973, p. 454.

[199] Flammarion, *Omega: The Last Days of the World*, 1894, p. 23.

[200] Ibid., p. 170.

> The dryness of the air, hot as the breath of a furnace, became intolerable, and a horrible odor of sulphur, probably due to the super-electrified ozone, poisoned the atmosphere. Everyone believed his last hour was at hand. A terrible cry dominated every other sound. The earth is on fire! The earth is on fire! Indeed the entire horizon was now illuminated by a bluish flame, surrounding the earth like the flames of a funeral pyre. This, as had been predicted, was the carbonic-oxide[201]

As it happens, this apocalypse is narrowly avoided, and Flammarion shifts to a lengthy discourse on how he sees the deep future of the planet playing out. However by then the potential consequences of a cometary impact have been described in detail—and they very much include the toxic vapours of the comet.

The idea of comets as potentially poisonous was further promoted by Rudolph Falb, an Austrian popularizer most famous for his unorthodox theories of volcanism. In 1894 these concerns were being only lightly expressed: "the comet is so light that no harm could result to the earth, unless the carbonic gas of which probably all comets consist should poison our atmosphere".[202] Successive publications of Falb's calendars of critical days increasingly emphasized this latter risk and by 1897 he was suggesting that "The earth itself will survive the shock, but everything living will be choked with poisonous gases and be finally cremated".[203]

The height of alarm about the poisonous potential of comets was reached in 1910 with the approach of Halley's comet, the tail of which was forecast to pass over the Earth. The presence of cyanogen was again the focus of concern. Flammarion once more took stage to downplay—but not rule out—the possibility of catastrophe.[204] Scenes of fear and panic

[201] Ibid., p. 174.

[202] 'Scientific', *Week*, 22 Mar. 1894, p. 30.

[203] 'An Austrian Row', *Daily News*, 22 Oct. 1897, p. 3.

[204] 'Our London Letter', *Argus*, 21 Feb. 1910, p. 8; 'World's Press Gleanings', *Mercury*, 8 Jan. 1910, p. 8.

were reported from around the world,[205] although as the writer for the *Wagga Wagga Advertiser* sardonically suggested, the prevalence with which such superstitions were attributed to 'others' induces some suspicion.[206]

This development of successive scientific theories of cometary destruction reveals the persistence of the cultural schema of comets as potentially catastrophic. Notably the three most significant late-century promoters of these theories—Proctor, Flammarion and Falb—were all professional popularizers. These people were all drawn to the cultural schemata that had deep resonances in people's lives. They found these questions the most important, and in turn their abilities in harnessing these schemata strengthened their appeal to the public.

The cultural schema of comets as powerful, potentially catastrophic bodies was durable even within a framework where the scientific knowledge about comets was changing rapidly, and when there would be many overt attempts to reject the cultural trope. These aspects show how the popular understandings of science involve multiple time scales—both the rapid time-scale of the epistemological development of scientific discourse and the slower time scale of cultural history.

---

205 'Halley's Comet. Weird Scenes in America', *Telegraph*, 4 Jul. 1910, p. 2; 'The Scare of Halley's Comet', *Maitland Daily Mercury*, 2 Jul. 1910, p. 8.

206 'Fear of The Comet', *Wagga Wagga Advertiser*, 24 May 1910, p. 2.

Sources: Tasmanian Archives and Heritage Office (top right), Allport Library and Museum of Fine Art (top left and bottom)

Figure 2.15 Illustrations of the comet of 1843

The Great Comet of 1843 appeared over Australia in early March, and was seen through the month. Easily visible in the daytime sky at its peak, its tail was the longest of any comet of the nineteenth century. A notable feature of the 'Australian Comet' was its original appearance in a southerly location and thus inability to be seen from the northern hemisphere at that time. This reinforced the role of astronomy in supporting the global imagination of colonial Australians.

These illustrations are by Mary Allport (top left), Walter Synnot (top right) and Morton Allport (lower), all of Tasmania. The drawing by Mary Allport was published in the *Proceedings of the Royal Society of Tasmania* and, the following year, in the *Illustrated London News*.

SURPRISE PAR LE FROID, LA DERNIÈRE FAMILLE HUMAINE A ÉTÉ TOUCHÉE DU DOIGT DE LA MORT, ET BIENTÔT SES OSSEMENTS SERONT ENSEVELIS SOUS LE SUAIRE DES GLACES ÉTERNELLES...

Source: Bibliothèque de l'Ecole polytechnique

Figure 2.16 Illustration from Flammarion's *Astronomie Populaire*, 1880

Camille Flammarion was the most successful astronomical popularizer of the late nineteenth century in France, and one of the most successful anywhere. His work was widely reported in Australia at the time.

In this illustration by Charles Mettais, Flammarion describes the fate of 'the last human family' overtaken by a creeping ice age. Flammarion would reprise these themes of the long-term future of the Earth and the possible destruction of humanity in his later eschatological essay-novel *Omega*. These apocalyptic speculations both drew on, and promoted, the appeal of the astronomical sublime, and in particular the cultural schema of astronomy as speaking of a source of power and danger.

2.5.2 Eclipses and transits

Comets were amongst the most engaging of astronomical events, but they were far from the most predictable. Recognising the regularity of Halley's Comet was one of the first major achievements of Newtonian astronomy and did more than perhaps any other single discovery to raise astronomy "from the rank of a science of observation to that of one admitting of the most exact mathematical deduction".[207] But the comets that were of most interest to astronomers and which also had the greatest impact on the public were the new discoveries, entirely unanticipated.

Astronomical phenomena like eclipses of the Sun and transits of Venus were entirely predictable. These were the phenomena that demonstrated to astronomers—in advance of Halley's return—that this science of the sky was mature. By the nineteenth century they were able to be forecast centuries in advance, and routinely reported in almanacs and newspapers. This precision of predictability was one of the major bases for the idea of astronomy as an exemplary science, the cultural schema that will be detailed in §2.6.3.

On average, there is a solar eclipse (when the Moon passes directly in front of the Sun as seen from Earth, thus obscuring the solar disk and leaving only the outermost layers of the Sun visible) once or twice a year, but a given eclipse is visible from only a small part of the Earth's surface, and so any region may not experience a total solar eclipse for decades at a time. Transits of Venus (when that planet passes directly between the Earth and the Sun, and so a silhouette is seen on the solar disk) are even rarer. Nonetheless, colonial Australians in the nineteenth century were able to see at least three total or annular (when a very small ring of the solar disk is still visible even at maximum eclipse) solar eclipses, in 1851, 1856 and 1857, and two transits of Venus, in 1874 and 1882.

[207] 'The Meeting of the British Association', *Sydney Morning Herald*, 19 Nov. 1869, p. 6.

Newspapers give direct reports of public participation in all of these events.[208] Notably the annular eclipse of 1851 and the total solar eclipse of 1857 and the 1874 transit were all predicted to be visible from Sydney.[209] The *Sydney Morning Herald* reported for the 1857 event:

> At an early hour on Thursday last, large numbers of townspeople, boarding schools, &c., were seen proceeding up the hills to catch a view of the first appearance of the sun. Rose Hill was the favoured spot, and certainly the selection was good, for from this eminence can be seen as much as in any part of Sydney, and although the horizon was cloudy, and we were thus far prevented from witnessing the eclipse, yet the glimpse obtained of the rising sun well repaid the trouble, The darkness after such a burst of light, seemed almost as "might be felt." The feathered tribes returned to their roosts, and all nature appeared to repose.[210]

While the *Empire* described

> A large portion of the city population rose early from their beds in order to be spectators of the occurrence. On most of the high grounds about Sydney clusters of people were assembled, and upon the cliff at the South Head there was a concourse of nearly a thousand persons, most of whom had provided themselves with the apparatus recommended for such occurrences—telescopes, coloured or stained glass, perforated cards, &c."[211]

---

208 'Local Intelligence', *Hobarton Guardian, Or, True Friend of Tasmania*, 5 Feb. 1851, p. 3; 'The Solar Eclipse', *South Australian Register*, 8 Apr. 1856, p. 3; '(No Title)', *Sydney Morning Herald*, 27 Mar. 1857, p. 4.

209 'Eclipse of the Sun', *Sydney Morning Herald*, 30 Jan. 1851, p. 2; 'The Solar Eclipse', *Sydney Morning Herald*, 12 Mar. 1857, p. 8.

210 'Parramatta', *Sydney Morning Herald*, 28 Mar. 1857, p. 5.

211 'The Solar Eclipse', *Empire*, 27 Mar. 1857, p. 2.

The thousand people at South Head alone was indeed a considerable portion of the city population, perhaps as much as ten per cent of local residents. The 1856 census recorded approximately 70 000 people in the city and suburbs.[212] That so many people knew of and planned for the eclipse itself speaks of an event of considerable interest. These reports also reveal an intriguing aspect of appreciation of the skies—that they are simultaneously characteristic of a particular place and yet shared by many places. The skies above can be seen from many places around the world; the particular views of them define, in part, the experience of a particular location. In seeking the best frames and social experience thousands of residents of Sydney engaged with the astronomical spectacle through a strong expression with local place.

No further total solar eclipses were visible in heavily colonised parts of Australia but two other predictable astronomical events were the 1874 and 1882 transits of Venus across the face of the Sun. Transits of Venus are quite rare events, with only two transits (separated by eight years) in more than a century. They are thus historically interesting, and even more so to colonial Australia as it was an observation of the 1769 transit that provided the overt justification for James Cook's first voyage, on which the east coast of Australia was mapped.

Transits are also scientifically useful in providing an absolute measure of distances in the solar system, and thus the distance between the Earth and the Sun. As a consequence, the observation of transits was a focus of considerable scientific organization. The 1874 transit saw seven international expeditions come to Australia and New Zealand, while the local observatories also organized multiple observational sites.[213] Australia was not quite as favourably situated for the 1882 transit, and nor was it as successfully observed, but there was a similar amount of press interest shown in the phenomenon.

[212] New South Wales Registrar General's Office, *Census of the Colony of New South Wales*, 1857.

[213] Orchiston, 'The Nineteenth Century Transits of Venus', *Journal of Astronomical Data*, 2004, 219.

The scientific importance of the 1874 transit was treated publicly. Numerous articles and lectures at the time detailed the techniques used to calculate the distance to the Sun.[214] It is doubtful as to how widespread were the understanding of the scientific methods behind this determination but the transit both spurred the activity of existing amateur astronomers—particularly the group of observers coordinated by Russell at the Sydney Observatory—and inspired new amateurs to take up the practice of astronomy. As Orchiston notes, the respected amateur Alfred Barrett Biggs commenced his observational career by assisting one of the United States of American expeditions in Tasmania.[215] Even amongst those with less astronomical inclinations, a certain amount of local pride was evident—sometimes hurt—for being the hosts of international scientific expeditions or for having been the site of the most successful observations.[216]

The 1874 transit also sparked a round of 'exhibitionist' letter-writing to newspapers, reminiscent of the arguments over the 1840s comets. The *Sydney Morning Herald* alone saw John Tebbutt renewing his feud with Russell, this time over the importance due to the Windsor observations, while also sparring with 'P.G.K.' over the accuracy of the printed almanacs; MacDonnell and Hirst arguing with A. Morris over the value of the observations from the colony; and 'Index' arguing with all of them about the point of observing the transit at all.[217] The nature of these disputes reflected the changes in the

[214] 'Scientific and Useful. The Transit of Venus', *Queenslander*, 14 Nov. 1874, p. 6; 'The Transit of Venus', *Launceston Examiner*, 8 Oct. 1874, p. 2.

[215] Orchiston, 'The Nineteenth Century Transits of Venus', *Journal of Astronomical Data*, 2004, 219.

[216] 'The Transit of Venus', *Cornwall Chronicle*, 4 Dec. 1874, p. 3; 'News in England on the Observations of the Transit of Venus', *Australian Town and Country Journal*, 13 Feb. 1875, p. 27.

[217] Hirst, 'New South Wales and the Transit of Venus of 1874', *Sydney Morning Herald*, 17 Apr. 1875, p. 10; 'The Transit of Venus', *Sydney Morning Herald*, 23 Apr. 1875, p. 7; Macdonnell, 'New South Wales and the Transit of Venus of 1874', *Sydney Morning Herald*, 17 Apr. 1875, p. 10; Morris, 'The Transit of Venus', *Sydney Morning Herald*, 14 Apr. 1875, p. 9; P. G. K., 'Transit of Venus', *Sydney Morning Herald*, 2 Feb. 1875, p. 6; Tebbutt, 'New South Wales and the Transit of Venus', *Sydney Morning Herald*, 21 Apr. 1875, p. 7; Tebbutt, 'The Transit of Venus', *Sydney Morning Herald*, 5 Feb. 1875, p. 2; Russell, 'The Transit of Venus', *Sydney Morning Herald*, 18 Jan. 1875, p. 3.

organization of science since the 1840s; while some of the questions at stake still involved contestations over individuals' prowess in calculation or observation, they also involved more substantial public questions such as the value for money expended on transit expeditions.

2.5.3 Conclusion for astronomical events

Spectacular astronomical events helped to keep astronomy before the public eye. With major comets seen in Australia in 1843, 1858, 1861, 1881, 1882 and 1910; total solar eclipses visible from densely populated parts of Australia in 1851, 1856 and 1857; and transits of Venus in 1874 and 1882 there was a major astronomical event visible from Australia on average every seven to eight years through the period of study. Including the 1833 Leonid meteor shower—also observed in Australia[218]—there was no more than a decade between two major events until the end of the 1880s.

These events also helped to reinforce the cultural schema of astronomy as an exemplary science. There were two aspects to this: the first that its observations were open to all and its subjects a part of the everyday world; the second that its calculations were exact, and it was able to forecast events like eclipses so far in advance.

Another consequence of these events was the extent to which they helped to consolidate the organization of astronomy. Observations of comets provided a focus for amateurs and their integration into the elite networks (albeit with variable success), while eclipses justified major expeditions arranged by government-funded observatories, both locally and from overseas. Either directly or indirectly, all of this organization had an impact on public perceptions of astronomy by keeping it a visible part of public culture.

[218] 'Singular Appearance in the Heavens', *Sydney Gazette*, 9 Apr. 1833, p. 2.

2.6 Astronomy in informal education: Mechanics' Institutes

Government funded observatories were not the only public institutions that promoted astronomy. Another well-known example was the set of organisations that comprised the Mechanics' Institute movement[219], the attempt to provide a place for education in scientific matters that catered to members of the working-class. This chapter will describe the use of popular astronomy in the Mechanics' Institutes of colonial Australia., with a particular focus on the lecturing activities of the Institutes in the period up until the 1860s. The astronomical content of the other main aspect of Mechanics' Institute, their libraries, will be discussed in §4.4.2. Some of the larger Institutes also conducted debating societies or formal classes; these will not be considered in detail in this thesis.

Mechanics' Institute lectures show the persistent association of popular astronomy with visual practice. As will be discussed with reference to Figure 2.17, astronomy lectures were far more likely to be illustrated than any other scientific subject. A more detailed discussion of these visual practices themselves will be deferred until Chapter 4. Here I give an overview of the Institute movement as it appeared in Australia, based primarily on the extensive secondary literature, and an examination of the use of astronomy within these Institutes in Australia, based on primary sources. This leads to a discussion of two more of the cultural schemata of astronomy based on these usages.

The Mechanics' Institute movement spread to Australia quite quickly after its beginnings in Scotland. This included the "fifty-nine emigrant mechanics, the greater part with wives

[219] Despite the variations in name for these institutions, including Mechanics' Institutes, Schools of Arts and Athenaeums, I will collectively refer to them as Mechanics' Institutes.

and families"[220] selected by Henry Lang for the voyage of the Stirling Castle in 1831 upon which Henry Carmichael commenced classes that studied all six books of Euclid—although "not above five or six of the mechanics on board continued to keep together as a class until the end of the voyage"[221]—and the first two books of *The Wealth of Nations*—for which class "thirty of the steerage class immediately inrolled themselves"[222]. Carmichael, and some of the 'emigrant mechanics' would go on to form a nucleus of the Sydney Mechanics' School of Arts. Lang, after its formation, would remain "aloof".[223]

The Van Diemen's Land Mechanics' Institute was even earlier, established in Hobart in 1827. The Institutes in both Hobart and Sydney appeared before many of the major British Mechanics' Institutes were founded. This rapid spread of cultural innovation to settler communities was a feature of the nineteenth century—one minor but surprising example of this phenomenon is the spread of downhill skiing to Australia and California before the practice was widely known in central Europe[224]—and is a reminder of how the circulation of *people* is an important aspect of the spread of practices, including cultural schemata.

The Mechanics' movement in Australia has attracted much attention in the literature. Nadel gives an early overview of its development: transplant from Britain, rapid spread in the 1840s and 50s, and then transformation of purpose around the 1880s.[225] Subsequently, numerous scholars have fleshed out this picture with more detailed histories of particular Institutes, comparative studies and revised assessments of the movements success, but the general picture presented by Nadel remains. [226]

---

[220] 'Advance Australia', *Sydney Gazette and New South Wales Advertiser*, 15 Oct. 1831, p. 2.

[221] 'Spirit of Discovery. New South Wales', *The Mirror of Literature, Amusement, and Instruction*, 5 Jul. 1834, pp. 69–72.

[222] Ibid.

[223] Nadel, *Australia's Colonial Culture*, 1957, p. 130.

[224] Masia, '150 Years of Skiing Down Under', *Skiing Heritage Journal*, 2011, 6; Kulberg, 'From Rock Carvings to Carving Skis', *Skiing Heritage Journal*, 2007, 34–37.

[225] Nadel, *Australia's Colonial Culture*, 1957, pp. 125–26.

[226] *Pioneering Culture*, ed. by Candy and Laurent, 1994.

The success of the Mechanics' Institutes in Australia is notable. In 1858, the Mechanics' movement was being described as in "decay"[227] , and their were aspects of this diagnosis that were accurate, but the movement would also thrive. Nadel compares favourably the membership of the Sydney Mechanics'' School of Arts with Manchester at the same time, relative to their respective population sizes.[228] Some Mechanics' Institutes did fail early, but many prospered, serving as the hub of 'respectable' entertainment in a town or suburb. This centrality of the Mechanics' Institutes to middle-class and upper working-class recreation derives in part from the disreputability of theatrical entertainments, described by Waterhouse and discussed earlier.[229] Especially in the rural areas of Queensland and New South Wales, the Mechanics' Institutes remained prominent cultural institutions and important sources of adult education well into the twentieth century.[230] In many places, the libraries were also still active, although in the absence of public subsidies, with relatively few remaining active without being absorbed into the public library systems.[231]

The heyday of lecturing within the Mechanics' Institutes in Australia is taken to be about 60 years from 1827. The annual reports used to compile Table 2.2 as well as the studies of individual Mechanics' Institutes in the various compilations, such as Buildings Books and Beyond, and *Pioneering Culture* show that in most Mechanics' Institutes the lecturing programs had petered out by the 1880s.[232] At the Melbourne Institute (later Athenaeum), between the years of 1864 and 1886 only 1874 saw a full lecture program. When lectures resumed in the late 1880s they were almost entirely on literary rather than scientific topics, a pattern that was common to many such Institutes. By this time almost

[227] 'The Decay of Mechanics' Institutes', *Empire*, 18 Feb. 1858, p. 3.

[228] Nadel, *Australia's Colonial Culture*, 1957, p. 111.

[229] Waterhouse, *From Minstrel Show to Vaudeville*, 1990.

[230] Beddoe, 'Schools of Arts and Technical Education in Queensland', 2004, pp. 100–109; Bryce, 'On the Wool Track with a Good Book: Shearers, Shedhands and Station Schools of Arts in New South Wales', 2004, pp. 116–21.

[231] Baragwanath, 'Mechanics' Insitute Libraries in Victoria, 1839-2004', 2004, pp. 42–86.

[232] *Buildings, Books and Beyond*, 2004; *Pioneering Culture*, ed. by Candy and Laurent, 1994.

everywhere the focus of the Institutes was as lending libraries thoroughly dominated by fiction.[233]

One of the major issues that has been explored in the scholarship of the Mechanics' Institutes concerns an understanding of the embedded class relationships of the Institutes, and in particular an assessment of the success of the movement with respect to the originally explicit goal of providing scientific education for the working classes. The conventional view, as expressed for example by Nadel, is that the movement was a failure in this respect, having not developed a base within the working class and with most Institutes taken over by the middle classes for their own use.[234] Shapin and Barnes have made the case for the British context that the promoters of the Mechanics' Institutes were both explicitly and implicitly seeking to develop a form of social control.[235]

Against this opinion Laurent has taken a revisionist stand arguing that in many places the Institutes were accessed by many members of the working classes to further their own ends.[236] Both arguments need to be considered in the context of the distinctive class relationships and different negotiation of the politics of class and culture in Australia, as described in § 2.1.

However it is considered to play out, evidence that this social control was recognised in Australia comes from the challenges to Mechanics' Institutes posed by Workingmen's Clubs, as in Hobart,[237] where the Mechanics' Institute quickly failed after the establishment of the rival organization. In the more diversified environment of Sydney,

233 *Pioneering Culture*, ed. by Candy and Laurent, 1994.

234 GH Nadel, *Australia's Colonial Culture*, 1957, pp. 153–56.

235 Shapin and Barnes, 'Science, Nature and Control: Interpreting Mechanics' Institutes', *Social Studies of Science*, 1977.

236 Laurent, 'Science, Society and Politics in Late Nineteenth-Century England', *Social Studies of Science*, 1984, 585–619.

237 W. M. C., 'The Mechanics' Institute and the Working Mens' Club', *Mercury*, 29 Mar. 1865, p. 2.

both Workingmen's Clubs and Mechanics' Institutes flourished.[238] A visiting lecturer Herbert Wigg explained the basis for the Clubs: Mechanics' Institutes "were established under the immediate patronage of the minister or the squire, or some philanthropist. The men felt a restraint, that the scheme was devised as the means of getting them under the minister's preaching, and they refused to go".[239] Further evidence for the recognition of these class relations, but on the other hand, comes from the name change of the Mechanics' Institute in Melbourne to the Athenaeum in 1872.[240]

One way in which this social control has been understood in the secondary literature is through the idea of 'rational recreation, with Mechanics' Institutes as one of the major exemplars. Proponents of rational recreation sought to develop new opportunities for leisure activities that were morally, physically and spiritually uplifting. One expression of this was given by Romanes:

> Recreation is, or ought to be, not a pastime entered upon for the sake of pleasure which it affords, but an act of duty undertaken for the sake of the subsequent power which it generates, and the subsequent profit which it ensures.[241]

The idea of 'rational recreation' has been more intensively studied in the British context than in the Australian, but the heyday of Mechanics' lectures in Australia can be seen as corresponding to the same period. In the colonial 'homeland', the era of 'rational recreation' fell between the 1830s, when many aspects of traditional working-class culture dissipated—or were made illegal—in the changes to an industrial society, and the 1890s, when mass media and advertising combined with new technologies to reshape the

[238] Morris and Bantermalis, 'Five Sydney Workingmen's Institutes', 2004, pp. 290–97.

[239] 'Workman's Clubs: Their Origin and Work', *Maitland Mercury and Hunter River General Advertiser*, 8 Jul. 1884, p. 3.

[240] 'Summary for Europe', *Argus*, 7 Nov. 1872, p. 1.

[241] Romanes, 'Recreation', *Nineteenth Century*, Sep. 1879, 401–24.

entertainment market.[242] The trajectory of the rational recreation movement was somewhat different in Australia, which, for the colonists, lacked a solid basis in traditional village-based popular culture, but the periodization is similar. According to Nadel, in the context of the Mechanics' Institutes:

> From the time of Carmichael's foundation lecture at the Sydney School of Arts to Windeyer's address, fifty years later, the idea of popular education was based on the social benefits of the diffusion of knowledge. In the earlier period, the innate virtues of theoretical knowledge and the moral improvement which flowed from it were emphasized. From the 'fifties onwards, the service of knowledge in the cause of social amelioration became the chief content of the idea. While knowledge was still an agent of improvement, it lacked the magic of the earlier days. Popular education could soon be considered a servant of social development rather than its cause.

As ever, it should be noted that the periodization is not precise; some of the ideologies of the rational recreation movement survived into the early twentieth century,[243] but they were by then isolated campaigns rather than a widely shared view.

However while the idea of 'rational recreation' was strong and Mechanics' Institutes were still committed to scientific education, lectures were one of the major vehicles through which such education would be provided. Astronomy was a prominent lecture topic in Australian Institutes, as will now be described.

[242] Bailey, *Leisure and Class in Victorian England*, 2014, p. 1.

[243] Jamison, 'Making "honest, Truthful and Industrious Men"', *Journal of Popular Culture*, 1999, 61–75.

2.6.1 Astronomy within Mechanics' Institutes

This section will examine the way that astronomy was used as a subject of popular lectures within the Mechanics' Institute. Unfortunately the evidence base for the content of these lectures is thinner than might be desired. Nadel noted sixty years ago the lack of description about the content of lectures in archival collections.[244] In many cases all that is available is a list of lecture topics for a given year from annual reports. In some instances, annual reports list only numbers of lectures without giving topics, and sometimes lecture programs were omitted entirely. Additionally, not all early Institute annual reports survive.

Table 2.2 provides a summary of lectures at four early major Mechanics' Institutes—Sydney, Hobart, Launceston and Melbourne—as garnered from these Institute annual reports, as available up until 1860. Given the general decline in lecturing at Institutes around this time, the precise choice of end date here is not crucial. The focus on literary topics in lectures from the 1880s, where they survived, was noted above. The Launceston Mechanics' Institute was still giving courses of scientific lectures, including one on astronomy by the amateur astronomer Alfred Barrett Biggs, as late as 1891,[245] but it was very much the exception.

The table is presented with: the total number of lectures in an official Institute-organized lecture program; the number of these devoted to scientific, as opposed to literary, historical or other topic that we would consider as within the fields of the humanities or social sciences; and the number of astronomical lectures.

Caution needs to be applied in interpreting the data presented in this table. As well as considerable missing data, there are obvious issues of interpretation involved in these classifications. Introductory lectures in these seasons were usually on the advantages of learning within the Institutes and would thus range over a wide ground, including much

[244] Nadel, *Australia's Colonial Culture*, 1957, p. 147.

[245] 'Current Topics', *Launceston Examiner*, 6 Jun. 1891, p. 2.

science, but these lectures have not been classed as scientific, On the other hand, phrenology, despite the extensive contestation that it already attracted at this time, has been considered as attempting to present a scientific view[246]. Technologies such as printing have been included as scientific while agricultural technology, in general, is not. The last category, as 'astronomical' or not, is more clear cut, although there is some overlap. Lectures on optical instruments, which will clearly discuss some astronomy, are not counted. Nor are those lectures including astronomy which are not counted as scientific, such as those on the history of astronomy and religious tradition, or natural theological lectures on the evidences provided by the organization of the universe for the promise of a future state.[247]

Despite these uncertainties, a number of consistent patterns across these Institutes. Also, of course, some differences. For its first decade the Sydney Mechanics' School of Arts faithfully delivered on the promise of 'useful' education. Most of its lectures in this time were scientific. In this context, astronomy lectures were somewhat more than ten per cent of the total. Towards the end of this time period the number of scientific lectures started to dwindle, before ceasing nearly entirely. The Van Diemen's Land Mechanics' Institute in Hobart is similar, although the decline of scientific topics in favour of others appears earlier and is more rapid. Launceston starts with a smaller program, but between Harbourmaster Matthew Curling Friend and Congregationalist Minister Charles Price, astronomy was the focus of nearly one in five scientific lectures, about twice the frequency of the previous two Institutes. The Melbourne Mechanics' Institute included more literary and sociological lectures from the beginning, but relative to the number of science lectures astronomy was at least as prominent as elsewhere.

Nadel identifies five groups of lecturers at Sydney in this period: the original Carmichael group of teachers; Sydney gentry; two groups of visitors—scientists and writers—and,

[246] Although a lecture from Hobart in 1855 titled "An evening with Burns including phrenological illustrations of his character" has not been counted as a scientific lecture.

[247] For an example of the former, see 'Melbourne Mechanics' Institution', *Age*, 31 Jan. 1856, p. 3; for an example of the latter, 'Dr. Udny's Lecture', *Cornwall Chronicle*, 10 Jun. 1843, p. 2.

after its establishment, professors from the University of Sydney.[248] Nadel argues that clergy were generally excluded at Sydney, although in Melbourne and the Tasmanian Institutes they were far more prominent. Of these groups the visitors provided no astronomical lecturers and neither did the University or the Sydney gentry. Astronomical lecturers came overwhelmingly from the clergy—such as John Lillie in Hobart, Charles Price in Launceston and Alexander Morison in Melbourne—and schoolteachers, such as Robert Giblin in Hobart, W. S Creeny in Sydney and Mr Boyd in Melbourne.[249] The original group of Sydney mechanics did produce at least one in the person of Mr Cox.[250]

A particular feature of these astronomical lectures was their association with visual technologies like magic lanterns or transparencies, as mentioned above. Figure 2.17 shows an advertisement for a course of lectures in Launceston in 1845. Only the astronomical lecture is advertised as being illustrated with lantern images. This is not an isolated case but rather representative of a consistent pattern. The seasons in Sydney in 1841 and in Hobart in 1846 are two others where the only lectures described as illustrated are the astronomical ones. Certainly at this time astronomical images were amongst the most readily available for the lantern but the association goes deeper than this. The persistent association of astronomical lecturing with visual technologies, and the way this shaped specific practices of trade and performance will be detailed further in § 4.2.

One source that does give detailed descriptions of the content of these astronomical lectures is newspaper reports. In this period some newspapers would occasionally print long reports of lectures. Where they exist, this is an invaluable source of information on the lecturing. In particular, this source reveals the themes consistently drawn upon in these lectures which will be used to articulate the cultural schemata of astronomy

---

248 Nadel, *Australia's Colonial Culture*, 1957, pp. 133–34.

249 'The Mechanics' Institution', *Courier*, 24 Dec. 1845, p. 2; 'Mechanics' Institute. The Rev C Price's Lecture', *Cornwall Chronicle*, 10 May 1845, p. 2; 'Concluding Lecture on Astronomy – The Astral Heavens', *Port Philip Gazette*, 13 Dec. 1847, p. 1; 'Mechanics' Institution', *Hobart Town Courier*, 28 Nov. 1829, p. 4; 'Lecture on Astronomy at the School of Arts, St. Leonards', *Empire*, 26 Jun. 1860, p. 5; 'Mechanics' Institution', *Port Philip Gazette*, 8 Sep. 1841, p. 4.

250 'To the Editor of the Sydney Monitor', *Sydney Monitor*, 6 Dec. 1834, p. 3.

discussed in this thesis. Many of these themes—the practical value of knowledge, astronomy as giving insight into religion, history of astronomy as a history of thought, astronomy as the exemplary science, and the visual associations of astronomy—are neatly articulated in Robert Giblin's lecture to the Van Diemen's Mechanics' Institute in 1829:

> He commenced his discourse by enlarging in neat and even elegant language on the great advantages to be derived from the study of astronomy, not only as a science useful to man in the common affairs of life, especially in chronology, agriculture, and navigation, but also in a moral point of view from its benign influence on the mind while engaged in contemplating the wonderful and infinite works of God. He then proceeded to illustrate the progress of the science, adverted to the discoveries in Chaldea and Egypt, and by a splendid transparent diagram shewed the system of Ptolemy, which however erroneous in supposing the earth to be stationary, and the whole heavenly bodies revolving round it, was correct in many points and laid the foundation of future discoveries. Mr. Giblin next proceeded to shew by an equally beautiful transparency the improved system of Tycho Brahe, who still supposing the earth to be stationary with the sun revolving round it, yet gave the double motion of the planets revolving round the sun at the same time. These led to the grand discovery of later times, in establishing on positive and scientific grounds the present solar system.[251]

The availability of these reports does vary considerably by newspaper title and city. There are multiple reports available for lectures in Melbourne, Hobart and Launceston, a few in Adelaide, but not many in Sydney, or in smaller population centres where newspapers had more limited resources.

Newspapers also contain advertisements for the whole series of lectures in some years, as seen in Figure 2.17. However a common refrain from many of the Institutes' reports concerned the difficulty of arranging lecturers and so having a whole season scheduled in

[251] 'Mechanics' Institution', *Hobart Town Courier*, 28 Nov. 1829, p. 4.

advance quickly became an uncommon luxury for the organisers. Accordingly, advertisements like Figure 2.17 become much less frequent.

Another source of information on lecturers and lecturers comes from broader Mechanics' movement materials. These were principally produced in Britain. Despite the significant differences between the way the Institutes developed in Australia compared with Britain, there is no doubt that the colonial proponents of the movement saw themselves as following a common practice, and so these materials are informative as to the likely beliefs and attitudes of many Australian lecturers.

Instruction in the sciences was one of the motivating principles of the Institute movement in its original form. Henry Brougham, one of the founders of the Society for the Diffusion of Useful Knowledge and a major patron of the Institute movement, felt that studying science "has, in all ages, been reckoned the most dignified and happy of human occupations".[252] Moreover, such pleasures were available to all, irrespective of class.

> Let any man pass an evening in listless idleness, or even in reading some silly tale, and compare the state of his mind when he goes to sleep or gets up next morning with its state some other day when he has passed a few hours in going through the proofs, by facts and reasoning, of some of the great doctrines in Natural Science, learning truths wholly new to him, and satisfying himself by careful examination of the grounds on which known truths rest, so as to be not only acquainted with the doctrines themselves, but able to show why he believes them, and to prove before others that they are true—he will find as great a difference as can exist in the same being; the difference between looking back upon time unprofitably wasted, and time spent in self-improvement: he will feel himself in the one case listless and dissatisfied, in the other comfortable and happy.

Science, for Brougham, was not just about improvement, but that improvement must necessarily lead to happiness.

[252] Brougham, *A Discourse of the Objects, Advantages, and Pleasures of Science*, 1827, p. 46.

All of these sources show that astronomy was appealing for early Mechanics' Institutes for a range of reasons. More than most sciences, astronomy satisfied the cultural expectations that knowledge be both useful and uplifting. Brougham himself articulated these twin justifications, the practical applications of astronomy to navigation as well as its spiritual significance:

> The advantage of this knowledge is therefore manifest in the common affairs of life; but it sinks into insignificance compared with the vast extent of those views which the contemplations of the science afford, of numberless worlds filling the immensity of space, and all kept in their places, and adjusted in their prodigious motions by the same simple principle, under the guise of an all-wise and all-powerful Creator.[253]

In Australia, these cultural expectations about knowledge were also held, and these justifications for astronomy would also be given. Mechanics' lecturers such as Launceston harbour master and lecturer Matthew Curling Friend would link it to navigation,[254] This connection to 'practical' matters would have been rather tenuous for much of his audiences, and Nadel has noted that in Australia the main forms of economic activity rendered the technical education of mechanics to be a of rather less utilitarian value than it was in Britain, but nonetheless this justification retained its rhetorical force. On the other hand, stalwarts of the Institute movement like John Lillie would focus more on the religious aspect of astronomy.[255] This latter link to the natural theology tradition, was particularly appealing to the many clerics who were founders of Mechanics' Institutes.

Early promoters of the Mechanics' Institutes movement in Britain, such as Brougham and Birkbeck were themselves devout Christians, and the same is true of Mechanics' in Australia. The irascible Presbyterian minister John Dunmore Lang[256] was one of the main

[253] Ibid., p. 23.

[254] 'Mechanics' Institute', *Launceston Examiner*, 6 Sep. 1845, p. 3.

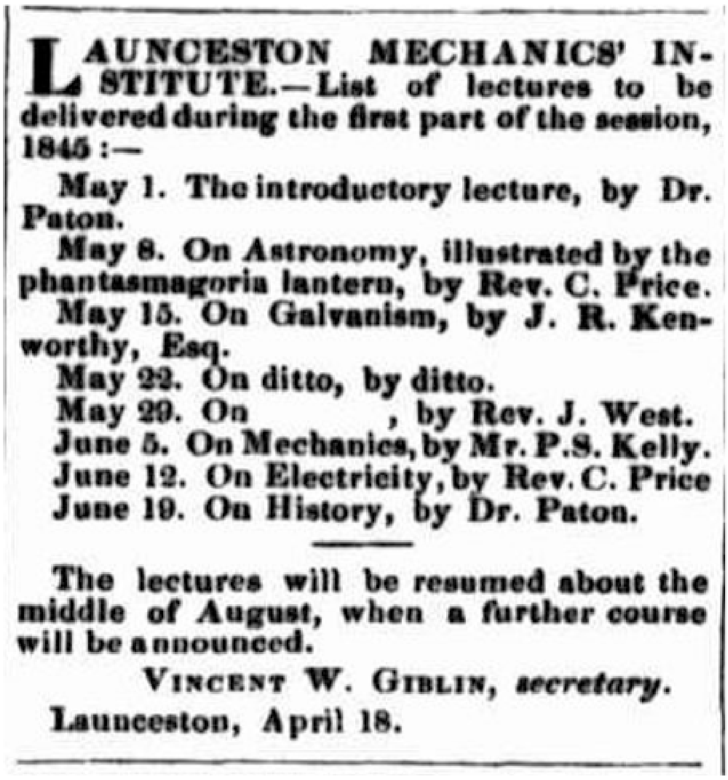
[255] 'The Mechanics' Institution', *Courier*, 24 Dec. 1845, p. 2.

[256] Baker, 'Lang, John Dunmore (1799–1878)'.

founders of the Sydney Mechanics' School of Arts, another Presbyterian minister John Lillie[257] was one of the principals of the early years of the Van Diemen's Land Mechanics Institution, and the Launceston Mechanics' Institute, one of the country's most successful, was in large part due to Congregational Ministers, first John West and later Charles Price.[258] Dissenting protestants in fact were heavily involved in the Mechanics' movement both in Britain and in Australia, although many orthodox Anglicans and a few Catholics were involved as well. Without doubt, for many members of the Mechanics' movement 'improving' education for the working classes very much included spiritual education, and here too astronomy had a strong role.

[257] Roe, 'Lillie, John (1806–1866)'.

[258] Reynolds, 'West, John (1809–1873)'; Lockley, 'Price, Charles (1807–1891)'.



LAUNCESTON MECHANICS' INSTITUTE.—List of lectures to be delivered during the first part of the session, 1845:—

May 1. The introductory lecture, by Dr. Paton.
May 8. On Astronomy, illustrated by the phantasmagoria lantern, by Rev. C. Price.
May 15. On Galvanism, by J. R. Kenworthy, Esq.
May 22. On ditto, by ditto.
May 29. On , by Rev. J. West.
June 5. On Mechanics, by Mr. P.S. Kelly.
June 12. On Electricity, by Rev. C. Price
June 19. On History, by Dr. Paton.

The lectures will be resumed about the middle of August, when a further course will be announced.

VINCENT W. GIBLIN, *secretary*.

Launceston, April 18.

Source: Trove

Figure 2.17 Launceston Mechanics' Institute lecture series, 1845

This advertisement shows the program for the first series of lectures organised by the Launceston Mechanics' Institute in 1845. It shows a number of typical features. Firstly, the lectures are primarily scientific in nature, as per the original mission of Mechanics' Institutes. However they would not be exclusively so, as shown by the lecture on history. Eventually literary and other non-scientific lectures would come to dominate. Secondly, lectures are held over winter, replicating behaviour from Britain. Thirdly, lecturers could be difficult to organise. The lecture topic on May 29 has not been specified.

Most importantly for this thesis is the association between astronomy lecturing and visual technology. Only one lecture is advertised as illustrated—the one on astronomy.

Table 2.2 Astronomical lectures at selected Mechanics' Institutes 1830–1860

Sydney Mechanics' School of Arts			
Year	**Total Lectures**	**Total Science**	**Astronomy**
1833	21	18	0
1834	20	15	4
1837	20	18	2
1838	19	11	0
1841	44	19	4
1844	21	10	3
1847	20	9	0
Van Diemen's Land Mechanics' Institute			
Year	**Total Lectures**	**Total Science**	**Astronomy**
1839	30	11	0
1842	21	18	1
1843	22	18	2
1847	28	17	2
1849	16	8	3
1855	20	3	1
Launceston Mechanics' Institute			
Year	**Total Lectures**	**Total Science**	**Astronomy**
1842	10	6	1
1844	16	12	2
1845	15	11	3
1846	4	2	0
1853	15	9	0
Melbourne Mechanics' Institute			
Year	**Total Lectures**	**Total Science**	**Astronomy**
1840	4	0	0
1841	7	4	0
1842	4	3	1
1849	13	1	0
1850	7	4	1
1853	17	6	0
1854	23	14	4
1855	10	1	0
1856	16	4	0
1857	8	1	0
1858	15	9	0

2.6.2 Cultural schema of astronomy: Astronomy as giving insight into religion

The idea of astronomy as giving insight into religion is a theme that is present throughout the history of popular astronomy and one that will recur through the case studies of this thesis. In particular Richard Proctor's reputation was in large part due to disputation over the religious implications of his astronomical ideas, described in § 3.6.2, while the role of astronomy within both the natural theology tradition and the freethought movement will be detailed in § 5.1. Nor was this connection confined to Christianity—Jewish rabbis would also lecture within Mechanics' Institutes on the connection between astronomy and religion[259]—or mainstream religions in general—Theosophists like Clement Wragge and Fred Cox would also lecture on this connection.[260]

Tracing the basis of this longstanding association is an interesting exercise. The idea that space and the divine are connected is so ingrained that its foundations are rarely articulated or examined. An appreciation that the objects of astronomical study are physically larger than the human realm and also contain it appears to be one understanding that forms a basis for this association. The physical forces required to create and move astronomical bodies is so vast that many saw them pointing to a power wholly beyond the human.[261] This idea acquired extra potency after the fundamental shift in the understanding of space and time associated with the rise of Newtonian science (although Bexley points out that Newton himself was not the most important figure in this transformation which had been developed and articulated by some of his predecessors[262]). Space was no longer compartmentalised but continuous and humans stood as one part of an incomparably large whole. This shift in understanding of space, when tied to the long-standing question of the plurality of worlds (to be detailed in § 3.3.1)

[259] 'Local Intelligence. Mechanics' Institute', *Colonial Times*, 27 May 1854, p. 3.

[260] 'The Late Mr. F. F. Cox', *Grenfell Record and Lachlan District Advertiser*, 1 Dec. 1900, p. 1; 'The Flight of a Soul', *Clarence and Richmond Examiner*, 17 Oct. 1911, p. 3.

[261] 'Divine Power as Seen in the Phenomena of Life', *Adelaide Observer*, 17 Mar. 1849, p. 2.

[262] Bexley, 'Absolute Time Before Newton', PhD thesis, 2009.

helped develop the sense of the astronomical sublime (described in §3.2.2). Certainly we start seeing explicit invocations of this sense in print from the seventeenth century, while by the early eighteenth century, it is not uncommon to see claims that

> There is something in the immensity of this distance that shocks and overwhelms the imagination, it is too big for the grasp of a human intellect: estates, provinces and kingdoms vanish at its presence.[263]

Another connection between astronomy and divinity came through the notion of perfection. Both before and after the Newtonian revolution in astronomy, in different ways, the idea of perfect motion was attached to celestial bodies. This idea will be described further in the next section.

2.6.3 Cultural schema of astronomy: Astronomy as an exemplary science

Astronomy was presented within the Institutes by lecturers such as Friend not just as spiritual but of worldly significance as well. This appealed to a broader cultural schema about knowledge in Victorian society, that knowledge should be practical. The emphasis on the precision of astronomy also drew on another of the main cultural schemata of astronomy in the nineteenth century and since: astronomy as the exemplar of sciences.

Astronomers had long prided themselves on having the most exact, mathematically pure science, dependent not on experimentation but only on observation and calculation. Richard Proctor described astronomy as the exemplary science which has discovered “the

[263] Berkeley, ‘(No Title)’, *Guardian*, 1 Jun. 1713.

true law of the solar system"; Stokes had said it was "one admitting of the most exact mathematical deduction".[264]

Another aspect of astronomy as an exemplary science is the focus on its own history. More than is the case in most popular sciences, astronomy deploys its own history. Very many, if not most, popular lectures on astronomy commenced with a review of ancient astronomy.[265] On one hand, the focus on the history of astronomy was related to the status of astronomy as a mature science by the nineteenth century; the transition from inexact to exact was one aspect that histories emphasized. Even more fundamentally the history of astronomy was that it reinforced the direct experiential aspect of astronomy: even ancient peoples without modern instruments or techniques could practice astronomy. William Thomas of Geelong would not be the only one who averred that "The starry heavens were objects of special attention from the earliest times, astronomy was in fact the most ancient of the sciences".[266]

This was an extremely common sentiment. The eminent man of science John Tyndall himself would trace the origins of science to ancient people's interest in the sky: "The apparent motions of sun and stars first drew towards them the questionings of the intellect, and accordingly astronomy was the first science developed".[267]

That astronomy was considered as both the oldest and the most perfect of sciences meant that its history was the most wide-ranging, starting before but also progressing further than those of other sciences. In this respect a history of astronomy subsumed the histories of other sciences; a history of astronomy stood for the history of science as a whole, or, since science was commonly regarded as the most perfect form of knowledge, as a history

[264] 'The Meeting of the British Association', *Sydney Morning Herald*, 19 Nov. 1869, p. 6.

[265] eg from many examples: 'Sydney Mechanics' School of Arts', *Sydney Monitor*, 15 Nov. 1834, p. 3; 'Mechanics' Institute', *Launceston Examiner*, 10 May 1845, p. 5; 'Lecture on Popular Astronomy', *Age*, 19 Jul. 1856, p. 2; 'Lecture on Astronomy', *Rockhampton Bulletin*, 25 Jul. 1872, p. 2.

[266] 'Town Talk', *Geelong Advertiser*, 21 Oct. 1873, p. 2.

[267] Tyndall, *Six Lectures on Light*, 1873, p. 13.

of thought itself. The Unitarian Minister A. B. Camm would give one of the fullest expressions of this idea in 1884 when he gave a lecture suggesting that the development of astronomical thought over history was itself a cause of ‘the growth of religious thought’.[268]

2.6.4 Conclusion for Mechanics’ Institutes

Although the cultural schema of astronomy as an exemplary science would continue, the rhetorical force of the specific justifications used within the Mechanics’ Institutes would diminish in the second half of the nineteenth century. As explored further in Chapter 5, the natural theology tradition experienced significant challenge, while as described in §§ 2.1–2 the direct connection to nautical practice would be lesser for late nineteenth century colonial Australians than for the generation earlier. As previously described, the ‘rational recreation’ framework within which the Institute movement had operated would itself ebb, as more emphasis was placed on the roles of formal education and social arrangements.

This aspect of the history of Mechanics’ Institute movement most clearly shows how social histories impact upon knowledge practices. However understanding that impact was far from simple. There was a wide spread of practice, discussed above, and a complicated relationship to class, described in § 2.1. These knowledge practices could be used in different contexts either to exclude the lower classes from middle class spheres of activity, as with the Melbourne Athenaeum, or to help promote working class people into higher circles. An example of the latter was Henry Parkes, for whom the Mechanics’ Institute in Birmingham was one of the social technologies allowing him to move from artisan to journalist and later politician, Premier of New South Wales[269]—and antagonist of Richard Proctor.

[268] ‘News of the Day’, *Sydney Morning Herald*, 11 Sep. 1884, p. 9.

[269] Martin, ‘Henry Parkes: Man and Politician’, *Melbourne Studies in Education*, 1960, 1–24.

The focus of this section has been on Mechanics' Institutes as amongst the first locations for the explicit public deployment of astronomical ideas. In so doing they reinforced existing cultural schemata about astronomy. and developed traditions of public lecturing and of lantern practice within the colonies.

The diversity of forms has been noted above: Mechanics' Institutes, Schools of Arts, Athenaeums and Workingmen's Clubs, to name some of these. It should also be noted that Mechanics' Institutes were however not the only such source. Other organisations, like the Young Men's Christian Association, appeared in this time and sponsored occasional lectures, commercial lecturers became more frequent through this time, and towards the end of the period discussed here the major observatories were founded, with practices of popularization around them. All of these would lay a foundation of practice for more professional lecturers like Proctor and Pepper.

2.7 Astronomy in education: ‘The Use of the Globes’

Another example of the way that astronomical ideas became bound up with broader cultural associations concerns education in ‘The Use of the Globes’.

2.7.1 Overview of ‘The Use of the Globes’

This subject was developed by Thomas Hood and Robert Hues in the late seventeenth century in response to concerns about the current state of British navigation, the subject was quickly adopted at the universities of Oxford and Cambridge, and, by the end of the seventeenth century was common in schools. The extent of its influence is described by Wallis: “From the 1590s until at least 1800 it is generally true that the teaching of geography at school and university centred on the use of the terrestrial and celestial globe.”[270]

The ‘Globes’ were a pair—one terrestrial and one celestial—which were constructed so that the globes could rotate on their axes within a brass ring (representing the meridian), while the brass ring could be rotated within a frame representing the horizon. Additionally, each globe was marked in a number of ways and contained a number of

[270] Wallis, ‘The Place of Globes in English Education, 1600-1800’, *Der Globusfreund*, 1978, 103–10.

appendages allowing measurements of angles to be taken. Figure 2.18 shows a typical pair of globes as used in school instruction.

‘The Use of the Globes’ taught a range of ways of manipulating these globes allowing answers to be obtained to questions such as the following:

> 24. At what rate per hour are the inhabitants of Botany Bay carried from west to east by the rotation of the earth on its axis?
>
> 115. The distance of a comet from Sirius was observed to be 66 deg. and from Procyon 51 deg. 6 min.; the comet was westward of Sirius; required its latitude and longitude?
>
> 121. Walking in Kensington Gardens on the 17th of May, it was twelve o’clock by the sun dial and wanted eight minutes to twelve by my watch; was my watch right?
>
> 151. Required the duration of dark night at the south of Nova Zembla.[271]

Thus this subject was a form of applied geography and astronomy. Notably, these questions were structured around a global imagination, and a particularly functionalist form of this imagination. The ability to be able to discern aspects of distant places and to relate them to conditions at home stood as a trope for the global networks of empire. Significantly the manipulations of the globes allowed the problems to be solved with only basic mathematical skills. This meant that it could be taught as a general subject—at least amongst those children with the appropriate class background. It was not uncommon for the writers of textbooks on ‘The Use of the Globes’ to explicitly downplay the mathematical sophistication of the subject with statements such as

[271] Keith, *A New Treatise on the Use of the Globes*, 1828.

> To a man in the habit of contemplating the writings of a Newton, or travelling in the dry and difficult paths of abstract knowledge, a treatise on the globes is a mere play-thing, a trifle not worth notice; as at one glance he sees and comprehends every problem that can be performed by them. Such a man would acquire no credit by writing a Treatise on the Globes; for notwithstanding the utility of the subject, its simplicity would leave no room for him to display his abilities; the task therefore necessarily devolves on writers of a more humble rank.[272]

Also significant was the fact that the ostensibly applied skills taught in 'The Use of the Globes' were, at least by the time period considered by this chapter of little real practical import. Although 'The Use of the Globes' originated as instruction in practical navigation, by the nineteenth century maritime navigators used different techniques to plot their courses. 'The Use of the Globes' was a refinement that gestured towards the skills of maritime navigation, but more significantly developed and supported a global imagination. Merchants need not be able to navigate a ship but their appreciation of global pathways was significant.

'The Use of the Globes' appeared quite early in Australian private school curricula alongside other features of English private school education such as classical languages in particular in boys' schools, and French, music and dancing in girls' schools. Although schools were where 'The Use of the Globes' were most strongly associated, pairs of globes did appear in other cultural institutions such as Mechanics' Institutes and public libraries.[273] It thus had the potential to support the global schema of Australia as a land under the southern sky. However for reasons that will be described, 'The Use of the Globes' failed to have a lasting effect on Australian cultural history.

[272] Ibid., p. vi.

[273] 'Local News', *Australian*, 10 Nov. 1838, p. 3; 'Domestic Intelligence. Mechanics' Institution', *Melbourne Argus*, 8 Jan. 1847, p. 2; 'News of the Week', *Leader*, 3 Feb. 1866, p. 2.

Figure 2.18 Pair of globes, Benjamin Martin, 12 inch

'The Use of the Globes' was a form of applied geography and astronomy that appeared primarily in private schools in the English tradition. It taught the student how to manipulate the globes as kinds of mechanical calculators in order to answer particular problems. Originally taught to both boys and girls in Australia, by the later part of the nineteenth century it was much more common in girls' schools, as part of 'accomplishments education'.

The pair of globes comprised one terrestrial—used for geography—and one celestial—used for astronomy. This pair of globes was produced by the noted London scientific instrument maker, Benjamin Martin.

2.7.2 ‘The Use of the Globes’ in Australia

The number of children who were directly exposed to this subject was small. However for those who did, it could clearly be a memorable experience. In 1907 John Tebbutt who was Australia’s most substantial amateur astronomer of the late nineteenth century would look back and write:

> In the course of instruction received by me in a select private school 60 years ago—and that under a tutor whose predilections were very strong in the direction of Latin and Greek—a pair of artificial globes was regarded as an important accessory. It was, indeed, partly owing to my instruction in the use of the globes that my attention was first drawn to a study of the noblest and grandest mechanism—namely, that of the heavens. I think that no school, public or private, is complete in its educational apparatus without a pair of globes.[274]

Another conclusion that can be drawn from these comments is that it is likely that at least some public schools were also provided with globes by benefactors, but it is unlikely that there were significant numbers of such. Certainly the evidence for such is not apparent in newspaper reports. In fact science as a broad field had only a small place in the curricula of public schools in this period from the 1840s–60s. Instead focus of these schools was strongly placed on the basics of literacy and numeracy. Other subjects, like astronomy, entered the school largely through the content of the readers that were used in the various schools. Those that were produced by the Irish Commissioners were of particular import in Australia as they were particularly favoured, but a number of others were used as well.

In the 1870s and 80s, the nature of education in Australia changed dramatically. This was due to both institutional and cultural reasons. The former was around the educational reforms enacted in the various colonies at this time. These eliminated the funding for

[274] Tebbutt, ‘Artificial Globes’, *Sydney Morning Herald*, 23 May 1907, p. 8.

denominational schools and established the 'free, compulsory and secular' system of education, which was dominated by the state schools. They also abolished 'payments-by-results' in favour of salaried payments for teachers. Cultural changes included the influence of educational reformers such as Pestalozzi and Froëbel. While there were many such strands that did not necessarily form a coherent whole, nonetheless these ideas would collectively come to be known as the 'New Education', and many of them would be adopted by education departments in the 1890s and 1900s through the influence of directors such as Cyril Jackson in Western Australia, Peter Board in New South Wales and Frank Tate in Victoria, as well as a generation of teachers who knew only the new institutional arrangements.[275] Some educationalists would justify these in moral terms, with the aim of education "to enable every individual to realize his or her highest activities, and to find the chief happiness in the pursuit of the good"[276] while others would cite more pragmatic grounds:

> Even the conservative employer of labour, who a few years ago voted against any State expenditure on primary education, now sees that much of future warfare is in production, manufacture and trade, and that schools rather than guns are the efficient weapons of this modern warfare.[277]

One aspect of these changes was that science came to acquire a more prominent position in public school curricula. In Victoria, for instance, schoolteachers were expected to deliver at least one science subject from 1880.[278] Initially this was through mechanisms such as the "object lesson" wherein students would study and describe a specimen from natural science. As scientific apparatus became increasingly cheap and available, more experimental techniques were introduced.

[275] Meadmore, 'The Introduction of the "new Education" in Queensland, Australia', *History of Education Quarterly*, 2003, 372–375.

[276] 'The Place of Nature Study in Education', *Education Gazette and Teachers' Aid*, 20 Jan. 1905, pp. 104–5.

[277] 'The "New Education"', *Education Gazette and Teachers' Aid*, 20 Feb. 1905, pp. 122–23.

[278] 'Science in State Schools', *Age*, 9 Aug. 1879, p. 6.

Astronomy, however, was not so well favoured by this change. With a new emphasis on actual observation and experimentation by pupils—and schooling hours entirely during the day—astronomy was one science whose presence actually diminished under the change. Observation of the Sun's position, and the construction of sundials was one example of an astronomical exercise that was possible.[279]

The older view of astronomy as a 'refinement' diminished particularly rapidly. Although defenders of the tradition remained—in 1871 a lead writer for the *Brisbane Courier* would still see the subject as an essential part of "polite education"[280] and John Tebbutt was defending it in 1907, general opinion in Australia quickly came to see the subject to be of little real value. In 1870, Jamaican liberal politician Henry Westmoreland would raise a laugh when he described 'The Use of the Globes' as part of the education the colonial government was providing for Jamaicans.[281] The subject was considered both useless and thoroughly old-fashioned:

> When elderly people who witness this wonderful change in education were young the school whose prospectus embraced "geography and the use of the globes" was looked up to with some respect but if it survived to this day it would be considered too low in the scale for the street Arab, and utterly inadequate to the requirements of Pentridge.[282]

By 1889 'The Use of the Globes' was being described as belonging to a "primitive" education system for ladies. It was contrasted especially with the 'useful knowledge' that was favoured by the new educationalists. One comparison that was made a number of times was with the manual arts programs for girls and boys known as Slöjd (later 'Sloyd') One newspaper article describing school examinations, including in the new subject, declared:

---

[279] 'Finding TIme by the Sun', *Education Gazette and Teachers' Aid*, 20 Feb. 1905, pp. 123–24.

[280] '(No Title)', *Brisbane Courier*, 22 Apr. 1871, p. 4.

[281] 'The Colonial Office and the Colonies', *Sydney Mail*, 29 Jan. 1870, pp. 6–7.

[282] 'Prominent Topics. Doing Justice', *Advocate*, 12 Apr. 1879, p. 10.

> The other day there was published an article on that indescribable branch of education called "Slojd," which may be indefinitely defined as the art of learning to do something and to make things. It is a branch of popular education which has been much neglected in favour of "ologies" and the use of globes, or in a lower stage, of exciting information regarding the exact locality of Petropaulovski and Timbuctoo. Now, the study of "ologies" and the use of globes is an excellent thing in its way, and most persons would even be prepared to admit on a rigorous cross examination that there may be occasions on which exact knowledge as to the locality of the places named might be of use, say to a Japanese naval student or an amateur African explorer. But as for one girl-pupil in our Public schools who becomes a Japanese naval student or an African explorer, there are probably several who will be called on to do duty as wives of Australian husbands or mothers of Australian children by-and bye, it is natural that people who take an interest in social conditions should hail with satisfaction the prospect of these girls learning to do some-thing and to make things. With girls learning to cook and make dresses, and boys undergoing technical instruction, we may hope to counteract that kind of school education limited to subjects of the "ologies"-and-use-of-globes species exclusively, which has turned out a rising generation of clerks and female typewriters elsewhere.[283]

This description does not just describe ‘The Use of the Globes’ as less than useful knowledge, it disparages lists of facts, like “the exact locality of Petropaulovski and Timbuctoo”, with skills. The term ‘exact’ is repeated: ‘The Use of the Globes’ provides exact knowledge, but not useful knowledge. There is, however, a particular interpretation of what is useful. Becoming “clerks and female typewriters” (which ‘The Use of the Globes’ has apparently helped to produce elsewhere) is not a useful outcome for women, but rather “duty as wives of Australian husbands or mothers of Australian children” is the highest aim. This is another stark reminder that the social relations of gender shape

[283] ‘Fugitive Notes’, *Sydney Morning Herald*, 19 Dec. 1891, p. 5.

knowledge practices, as do those of class: at least one report from Paris forecast that 'The Use of the Globes' would be replaced by fencing in "the higher schools for girls".[284]

The emphasis on a proper education for wives and mothers had, in fact, been precisely the justification used for teaching those same science subjects to women in an earlier generation. It is a notable fact that 'The Use of the Globes' persisted in middle-class girls' schools longer than in boys' ones, and this was part of a broader emphasis on science for girls. This emphasis was a feature of nineteenth century education around the world. Phillips has shown for Britain, and Tolley for the USA how girls' private education at this time rested significantly more heavily on the sciences than boys' schools, which depended more on the classics.[285] The evidence of schools' advertisements in Australia suggests that this was also true for Australia in the period before the educational reforms; that women went on to become significant audiences for popular science in general and astronomy in particular is suggestive that this association of girls' education with science was at least a contributing factor in Australia.

Table 2.3 documents advertisements for 'The Use of the Globes' at schools in 1860, 1870 and then from 1875–1900. These need to be interpreted with some caution —when a school is advertising the subject in 1879 and 1888 it is quite likely that it has also been taught in the intervening period, and thus that these advertisements might significantly undercount actual practice. Nonetheless several features are clearly evident from these advertisements. Firstly, in 1860 the subject is being taught at both boys' and girls' private schools, but by 1870 it is almost entirely girls' schools that are teaching it. Secondly, the number of schools with the subject decline dramatically after 1870—the advertisement numbers actually fall off a cliff after 1872. Thirdly, it is Catholic schools that retain the tradition longest. After 1875 the only schools advertising the subject were Catholic girls convent schools, maintaining their traditions of private education in the face of reduced, and eventually entirely removed public funding.

[284] 'Ladies Letter from Paris', *Telegraph*, 9 Nov. 1892, p. 2.

[285] Phillips, *The Scientific Lady*, 1990; Tolley, 'Science for Ladies, Classics for Gentlemen', *History of Education Quarterly*, 1996, 129–153.

In any case, by the end of the century the subject would be a metaphor for both the antiquated and impractical, a symbol of the pointless refinements of the wealthy.

> When education had reduced itself to elegant extracts and the Use of the Globes it was hardly wonderful that the rebound would spring as far as Kant and the higher mathematics.[286]

Almost always, astronomy was associated with positive—or at least powerful—attributes when invoked in cultural references. ‘The Use of the Globes’ provides a rare example in which astronomical practices were associated with negative opinions in public culture in this time period. In the context of the social history of Australian education the cultural schema of knowledge as useful came to control the meaning of this particular popular astronomical practice.

[286] ‘A Woman’s Warning’, *Australasian*, 22 Dec. 1900, p. 35.

Table 2.3 Advertisements for 'The Use of the Globes' at schools in 1860, 1870, and 1875–1900

1860 (12)		
Ladies School, Singleton	NSW	Girls
Lyceum School, Sydney	NSW	Boys
Orwell House, Darlinghurst, Sydney	NSW	Girls
Sunbury House, Sydney	NSW	Girls
Mrs. G. M. Tweedie's Morning Classes, Woolloomooloo	NSW	Girls
South Adelaide Educational Institution, Adelaide	SA	Girls
Launceston Grammar School, Launceston	Tas	Boys
Ballarat Collegiate School, Ballarat	Vic	Boys
Kyneton Seminary, Castlemaine	Vic	Girls
Mrs Brown's Academy, St Kilda	Vic	Girls
Portland National Grammar School, Portland	Vic	Boys
Williamstown Academy, Williamstown	Vic	Boys
1870 (6)		
St Bridgets Convent School, Albury	NSW	Girls
St Johns School, West Maitland	NSW	Boys
St Mary's Dominican Convent School, Adelaide	SA	Girls
Presentation Convent School, Hobart	Tas	Girls
Our Immaculate Lady of Mercy Convent School, Fitzroy	Vic	Girls
Queens College, Geelong	Vic	Girls
1875–80 (total 5)		
Sacred Heart Catholic High School, West Maitland	NSW	Girls
Immaculate Conception Convent School, Balmain	NSW	Girls
Good Samaritan Convent School, Sydney	NSW	Girls
St Mary's Dominican Convent School, Adelaide	SA	Girls
Our Lady of Mercy Convent School, Sandhurst	Vic	Girls
1880–85 (total 3)		
St Vincent's Ladies College and Preparatory School, Sydney	NSW	Girls
Presentation Convent, Hobart	Tas	Girls
Our Lady of Mercy Convent School, Sandhurst	Vic	Girls
1885–1900 (total 6)		
Good Samaritan Convent School, Richmond	NSW	Girls
Holy Cross Convent School, Cooma	NSW	Girls
Immaculate Conception Convent School, Balmain	NSW	Girls
St Brigid's Convent School, Cundletown	NSW	Girls
St Patrick's Convent School, Campbelltown	NSW	Girls
Presentation Convent, Hobart	Tas	Girls

2.8 Conclusion

This chapter examined the most conspicuous, and the most significant ways in which astronomical ideas featured in public culture in the period 1840 to 1880. Scientific discourse was one cultural concern amongst many, yet ideas about astronomy and the sky were consistently given a central place within this discourse. Astronomical ideas helped shape notions of place, community and identity in the Australian colonies at this time.

Astronomical ideas were particularly influential when harnessed to emotionally powerful experiences, such as memories of home or visions of independence. In the analytical framework adopted in this thesis, these ideas about astronomy became cultural schemata.

This chapter has outlined a number of the major schemata that were associated with astronomy in the nineteenth century. Four of these were particularly discussed: the notion of Australia as a land under the southern sky, and the sky as a site of power and danger, astronomy as giving insight into religion, and astronomy as an exemplary science.

These cultural schemata show how the concerns of popular science become enmeshed with meanings from non-scientific aspects of people's lives. In the first case the stars invoke memories of distant people and places, and both the memories and their perception of distance help to forge a collective identity. In the second case it is the connection made between astronomy and the ever-present disasters that can come from the sky that has meaning.

All of these cultural schemata also show the aspect of stability over time. Most notably, ideas about comets were repeatedly presented in the apocalyptic framework of disaster and destruction. This was in the face of rapid changes in scientific understandings about comets. Each of these changes would be represented in the apocalyptic framework: in the

1820s the concerns were that a cometary encounter with the Earth would trigger climate catastrophe; in the 1880s it was impact with the Sun that would cause the end of the world while in the 1900s poisonous gases in comets would extinguish all life. This shows how schemata operate through engaging understandings from different historical scales.

Other case studies in this chapter show that social histories are important: social organizations can have a powerful effect on the performance of knowledge practices. This was especially evident with respect to the teaching of 'The Use of the Globes', which was both constructed and then dismantled around notions of appropriate education for women, with a strong class basis.

The action of cultural schemata will be described further in the next chapter, which studies the Australian activities of Richard Proctor and Professor Pepper, two of the most high-profile professional popularizers of their time. These popularizers were successful in large part because of their skill in harnessing the cultural schemata of astronomy. A fifth cultural schema of popular astronomy will also be described in the next chapter: astronomy speaks to the human condition through the possibilities of life elsewhere.

3: Richard Proctor: professional science communication in Australia in 1880

In 1880 two of the most renowned scientific popularizers in the English-speaking world were down on their luck. John Henry 'Professor' Pepper had been director of the Royal Polytechnic Institution for twenty years before falling out with the management. Setting out on independent ventures, he proceeded to lose money. The astronomer Richard Anthony Proctor, also in financial distress, and suffering personal tragedy with the death of his wife also came to Australia hoping for a venture both diverting and lucrative.

It should be no surprise that Australia was a choice destination for professional popularizers. In the post-goldrush era Australians enjoyed the highest incomes in the world[287] and moreover had a high proportion of well-educated workmen. Throughout the nineteenth century British migrants to Australia were not “the poorest of the poor”,[288] and there had been a significant influence from Chartist ideals.[289] Proctor’s later antagonist Henry Parkes himself had once associated with Chartism.[290] Both of these factors helped shape a society with a relatively healthy respect for knowledge and learning.

Howsoever understood, Proctor enjoyed a resounding success of his tour of Australia and New Zealand in 1880. This chapter will examine this tour in detail, describing how and

---

[287] McLean, *Why Australia Prospered*, 2012, pp. 11–12.

[288] Richards, ‘How Did Poor People Emigrate from the British Isles to Australia in the Nineteenth Century?’, *Journal of British Studies*, 1993, 250–279.

[289] Harris, ‘The Influence of Chartism in Australia’, *The Royal Australasian Historical Society: Journals and Proceedings*, 1926, 351–378; Collins, ‘Political Ideology in Australia’, *Daedalus*, 1985, 147–69.

[290] Pickering, ‘Betrayal and Exile: A Forgotten Chartist Experience’, 2016, pp. 201–18 (p. 210).

why Proctor made such an impression on Australian cultural life. In particular, it will show how Richard Proctor consciously and skilfully deployed the cultural schemata of astronomy outlined in the previous chapter.

The focus is on the Australasian activities of Proctor. This tour had a high profile at the time and there were long memories of it.[291] One episode in particular, the Proctor–Parkes incident, was especially notorious. Nonetheless, neither the tour nor the Proctor–Parkes incident have been well studied. There is only one academic publication that directly addresses the dispute[292] while Proctor's tour does not appear in any of the major works on the history of Australian astronomy. Proctor's appearance in these histories is generally limited to his role in the controversy about Eta Argus.[293]

Proctor had some biographical similarities with Flammarion. He, too, had seen his family fortune disappear. He, too, had turned to popularization and had a breakthrough success with a book on life on other planets. He, too, had longstanding interest in the relationship between astronomy and spirituality. Former Secretary of the British Astronomical Society, recognised expert on the planet Mars, renowned author, Richard Proctor was in 1880 one of the most famous scientific popularizers in the English-speaking world.[294]

The historical lacuna concerning Richard Proctor in Australia is therefore notable. In recent decades, scholarship has started to fill the gap between the importance of popular processes for the history of science and the cultural value of scientific discourse, from both directions. Richard Proctor is a well-studied figure in this regard but his Australian activities have received almost no attention. This chapter describes both the broader

[291] 'Proctor's Paradoxes', *Recorder*, 7 Jun. 1922, p. 4.

[292] Phillips, 'The Churches and the Sunday Question in Sydney in the 1880s', *Journal of Religious History*, 1970, 41–61.

[293] Haynes, *Explorers of the Southern Sky*, 1996, p. 137; Orchiston, 'The Contribution of Francis Abbott to Tasmanian and Australian Astronomy', *Vistas in Astronomy*, 1992, 315–44.

[294] Lightman, *Victorian Popularizers of Science*, 2009, p. 299.

cultural reception of the tour and the specific details of Proctor's lecturing in order to place the tour in the cultural schemata outlined in the previous chapter.

Professor Pepper's[295] tour of Australia in 1879–80 and subsequent residence in Brisbane from 1880–89 had fortunes that were much more mixed. By 1880 Pepper's performance seemed more like an assemblage of individual components than presenting as a strong narrative within a cultural framework. Pepper invoked a performance style that seemed old-fashioned while Proctor was a good embodiment of contemporary standards for authority. Although the significant differences between the two mean that the comparison is not exact, nonetheless it is fascinating to contrast two popularizers with a similar reputation lecturing about similar topics in the same towns. This chapter will also include such a comparison. Pepper had a significantly smaller impact on late-19th century Australia, both at the time and in the decades afterwards. Pepper would be remembered neither as well nor as long as Proctor.

[295] I will throughout this thesis use John Henry Pepper's stage name of 'Professor Pepper'. While Proctor, and other lecturers referred to in this thesis were given the apellation Professor, for no one else was it such a constant feature of their public identity.

3.1 Proctor in Australia

Proctor's 1880 tour was a great success. He delivered more than a hundred lectures, mostly to sell-out audiences.[296] People remembered Proctor and referred to him for many years to come.[297] No doubt much of the success of the tour was due to the skilful management of Robert Sparrow Smythe,[298] nicknamed the "Moltke of Managers"[299] for his careful planning, and many successes, after the famous German Field Marshal. A former journalist, Smythe had been active in theatrical management for nearly twenty years prior to Proctor's tour, and had built up a wealth of experience of the Australian scene. Certainly Proctor attributed much of his success to Smythe.[300]

Despite the favourable pre-conditions, the success of the tour was not obvious beforehand. Platform lecturing did not have a strong tradition in Australia at that time. Smythe himself had managed few speakers previously, most successfully the Reverend Charles Clark.[301] Smythe refused to guarantee even Proctor's passage out, so uncertain he was of the prospects (although this may have been because, contrary to Smythe's practice, he had not yet had a chance to hear Proctor speak[302]). Yet Proctor earned around £5000, more than he had on his first tour of the USA and many times a government or university

[296] '(No Title)', *Otago Daily Times*, 7 Dec. 1880, p. 2.

[297] 'Proctor's Paradoxes', *Recorder*, 7 Jun. 1922, p. 4.

[298] Shillingsburg, 'Smythe, Robert Sparrow (1833–1917)'.

[299] 'The Moltke of Managers', *Sydney Morning Herald*, Jun. 1914, p. 5.

[300] Ibid.; Proctor, 'Mr Proctor's Farewell', *Argus*, Jan. 1881, p. 7; 'Mr Proctor the Astronomer', *New Zealand Herald*, Dec. 1880, p. 6.

[301] 'A Great Entertainer', *Evening Journal*, 11 Sep. 1896, p. 2.

[302] Hardiman, 'RS Smythe/RA Proctor' (email), pers. comm., 19 Feb. 2013.

astronomer's salary.[303] It was reported that Proctor cleared as much in Dunedin alone as he had in New York.[304] Both his memorability and his takings in New Zealand were only helped by the earlier controversies of his visit: chiefly the intervention of NSW Colonial Secretary Sir Henry Parkes[305] to stop Proctor from delivering a Sunday lecture.

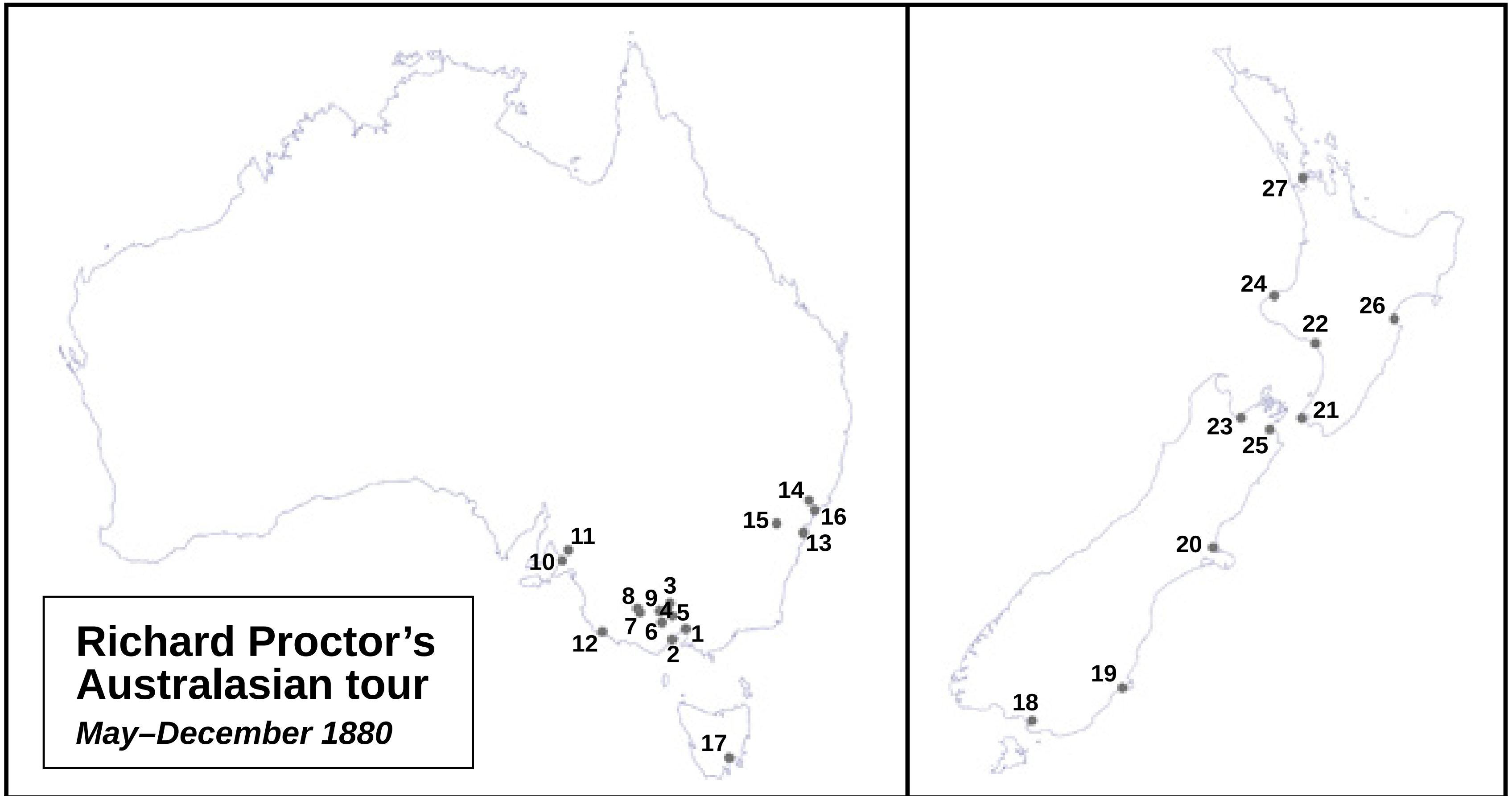
Beyond the skill of his manager, Proctor's success was grounded in many other aspects of his performance. His lectures were presented with a strong overall framework that engaged contemporary issues—and the aforementioned controversies—in science, philosophy and religion. His public authority drew on a reputation as a current expert in his subject-matter, knowledgeably discussing recent events in science and employing up-to-date technologies. Overall, he presented as a modern lecturer, in stark contrast to Pepper, who carried with him the association of the style of an earlier generation.

Proctor in Australia—and for most of his career elsewhere—had a repertoire of seven lectures. The first, and most commonly delivered, was "Life and Death of a World", in which he outlined his framework of cosmic evolution with respect to the Earth and other planets. Most of his other lectures focused on particular solar system or stellar objects. “Other Worlds than Ours” gave his views on the subject with which he first had success—the possibility of life on other planets, known at the time as the ‘plurality of worlds’ debate. Proctor's final lecture, "The Birth and Growth of the Universe" described his view of the relations between science and religion, discussed nebular theory and reprised his framework of cosmic evolution. Proctor modified this last one into "The Vastness of God's Universe" in Australia after the Parkes incident. Despite claiming that his success in New Zealand was largely due to the Parkes controversy, he did not deliver his seventh lecture there. Only Melbourne and Sydney audiences heard and saw all seven. Figure 3.1 and Table 3.1 summarise Proctor's lecturing schedule in Australia and New Zealand as gleaned from analysis of newspaper reports and advertisements.

303 ‘An Editor and the “Much Travelled”’, 6 Oct. 1914, p. 5; Lightman, ‘Marketing Knowledge for the General Reader: Victorian Popularizers of Science’, *Endeavour*, 2000, 100–106.

304 ‘(No Title)’, *Thames Advertiser*, 19 Jan. 1881, p. 2.

305 Martin, ‘Parkes, Sir Henry (1815–1896)’.



1	Melbourne	27 May–28 Jun	7	Ararat	23 Jun
2	Geelong	7–10 Jun	8	Stawell	24–25 Jun
3	Bendigo	14–15 Jun	9	Maryborough	29 Jun–1 Jul
4	Castlemaine	16 Jun	10	Adelaide	9–21 Jul
5	Kyneton	17 Jun	11	Gawler	22 Jul
6	Ballarat	21–22 Jun	12	Mt Gambier	29 Jul–2 Aug
13	Sydney	16 Aug–10 Sep	18	Invercargill	5–7 Oct
14	Maitland	30 Aug–1 Sep	19	Dunedin	12–21 Oct
15	Bathurst	6–8 Sep	20	Christchurch	25–29 Oct
16	Newcastle	13–15 Sep	21	Wellington	1–5 Nov
1	Melbourne	20 Sep	22	Whanganui	11–13 Nov
17	Hobart	27–29 Sep			
23	Nelson	16–18 Nov			
24	New Plymouth	22–23 Nov			
25	Blenheim	26–29 Nov			
26	Napier	6–10 Dec			
27	Auckland	15–24 Dec			

Table 3.1 Summary of Richard Proctor's lecture schedule in Australia and New Zealand, 1880

	Life and Death of a World	The Sun	Other Worlds than Ours	The Moon	Comets and Meteors	The Star Depths	Birth and Growth of the Universe/ Vastness of God's Universe
Melbourne	●	●	●	●	●	●	●
Geelong/Most regional Victoria	●	●					
Adelaide	●	●	●	●	●		●
Mt Gambier	●	●		●	●		
Sydney	●	●	●	●	●	●	x●
Maitland/Bathurst	●	●		●			
Newcastle	●	●	x				●
Hobart	●	●		●			
Dunedin/Christchurch	●	●		●		●	
Wellington	●	●		●	●	●	
Auckland	●	●	●	●	●	●	
Most other NZ	●	●		●			

● Lecture delivered

x Lecture scheduled but cancelled

3.2: Techniques in 'Life and Death of a World'

Proctor began without any introductions or prefatory remarks, walking on stage and starting to talk about his subject.[306] This was evidently a successful technique. According to the *Australasian:*

> From the first word the lecturer secured the attention of the audience and he held it to the close of his discourse. It is something to closely and strictly hold with a scientific subject the mind of a general audience, not specially trained or familiarised with the subject, for an hour and a half without a break, and without wavering or wandering in their attention. But this Mr. Proctor did triumphantly and without a check, and succeeded in leaving them on better and more cordial and more intimate terms with the solar system than they had ever felt before.[307]

This ability to hold an audience was no doubt due to his comprehensibility, how he made numbers seem easy and his good humour and pleasing manner. He had a "clear voice" with "no hesitation over an expression or fact"—although some did feel that his delivery was too monotonous.[308]

[306] 'Mr Proctor's Astronomical Lectures', *South Australian Register*, 10 Jul. 1880.

[307] 'The Critic. Mr. R. A. Proctor as a Lecturer', *Australasian*, 5 Jun. 1880, p. 6.

[308] Ibid.; Enquirer, 'Teetotal Advocacy', *Bunyip*, 10 Sep. 1880, p. 3; 'Our City Letter', *Kapunda Herald*, 13 Jul. 1880, p. 3; 'Mr. Proctor's Astronomical Lectures', *Argus*, 28 May 1880, p. 6.

3.2.1 History

In his primary lecture, "Life and Death of a World", first words were:

> From time to time we learn that the great astronomers Copernicus, Galileo and Newton first discovered and established the true law of the solar system, and it was only after that discovery that men began to recognise the vastness and immensity of the scale on which the universe is built.[309]

This nod to Copernicus, Galileo and Newton invokes the schema of the history of astronomy as an exemplary science. In fact this reference is a very commonly deployed technique of Proctor's. The start of every one of his lectures included a reference to historical astronomy, whether to earlier superstitions in "Comets and Meteors—the Largest and Least of Heavenly Bodies" or a description of the Mesopotamian origin of constellations in "The Star Depths; or the Glories of the Heavens". Nor was this focus on history unique to Proctor; the strong association between popular astronomy and the history of astronomy was described in § 2.6.3.

[309] Proctor, *Life and Death of a World*, 1880, p. 3.

3.2.2 Cultural schema of astronomy: Astronomical sublime

This introductory passage of Proctor's also opens up a second of his techniques, an appeal to the sublime. Ideas about the sublime had, by the nineteenth century, a long tradition drawing on the works particularly of Kant and, for the Anglosphere, Burke. The latter author describes the sublime as "that state of the soul in which all its motions are suspended, with some degree of horror" such that "the mind is so entirely filled with its object, that it cannot entertain any other, nor by consequence reason on that object which employs it".[310] More succinctly, Golinski describes it as "an aesthetic effect distinct from the appreciation of beauty, one in which a measure of awe or fear was mingled".[311]

Again, the association between astronomy and the sublime was not unique to Proctor. The connection between the sense of the sublime and astronomy had already been much noted by Proctor's time. According to British scientist and lecturer Joseph Priestley, astronomy was one of "the noblest fields of the sublime that the mind of man was ever introduced to."[312]

The precise bases for the appeals to the sublime in astronomy are various. Some spoke of the grandeur of the mechanics coordinating the motions of the heavens, a common theme for lecturers from the natural theology tradition who dwelt on astronomy, as will be discussed further in Chapter 5. This drew on the cultural schemata of astronomy as an exemplary science and as giving insight into astronomy. For others, it was an appreciation of the sheer geometrical vastness of the universe and hence smallness of Earth, which itself was a consequence of the Newtonian understanding of space and which drew on similar bases. For example Humboldt in *Cosmos*, in an extract which was republished in the Australian press, suggested that "The feeling of the sublime" that came from astronomical thoughts "so far as it arises from the contemplation of physical extent,

[310] Burke, *A Philosophical Enquiry Into the Sublime and Beautiful*, 1998.

[311] Golinski, *The Experimental Self*, 2016, p. 27.

[312] Priestley, *A Course of Lectures on Oratory and Criticism*, 1781.

reflects itself in the feeling of the infinite which belongs to another sphere of ideas".[313] Proctor, as has been seen, emphasized the destructive powers of astronomical forces, that is the cultural schema of the sky as a site of power and danger. A final role of the sublime in astronomy suggested by Golinski is to protect speculations about life on other planets against suspicions of theological heterodoxy—the cultural schema of astronomy as giving insight into the human condition through considering life elsewhere.[314] Of course most popularizers combined several of these appeals.

The astronomical sublime is itself a powerful schema of astronomy. Due to these multifaceted underlying bases, I will here regard it as a combination of several of the schemata that I have identified: the sky as a site of power; astronomy gives us insight into religion; and astronomy speaks to the human condition through the possibilities of life elsewhere. It was noted earlier that it is a feature of cultural schemata that they are self-referential—one schemata can invoke others. Consequently the precise distinctions between different schemata is fuzzy, and the choices made here are for the purposes of analytical utility.

[313] von Humboldt, *Kosmos*, 1845.

[314] Golinski, 'Sublime Astronomy: The Eidouranion of Adam Walker and His Sons', *Huntington Library Quarterly*, 2017, 135–57.

3.2.3 Cosmic evolution

One of Proctor's particular interests in deploying an appeal to the sublime was to promote the overarching framework of his lectures, the idea of cosmic evolution. Shortly after the introductory passage quoted at the start of this § 3.2 Proctor would say

> The cycles of change affecting the universe must be vast, and although the gradual changes amongst the earth's solar system, and even in the other planets and the stars, are so very slow and so minute that they are almost imperceptible in a man's life time, yet it cannot but be acknowledged that changes have taken place, are now taking place, and will continue to take place. As a proof we have other globes like the earth we live in, which must have gone through the same processes, the gradual process of change that under our very eyes are taking place on this earth and have now reached a stage of life—a stage in a planet's life utterly unfit for the sustenance of animal life.[315]

This passage expresses Proctor's framework: the universe, and all objects within it undergo a process of change; different planets age at different rates; and the suitability of a planet for life depends on its position within its life-cycle. More metaphorically, Proctor would continue by explaining that worlds run their course "through burning childhood, fiery youth, manhood, old age and decrepitude, to the final stage—that of death".[316]

Proctor's theme of cosmic evolution connected both physical conceptions of the solar system—the Moon, whose "aridity and want of atmosphere indicate old age",[317] the large, gaseous planets Jupiter and Saturn which "scientifically speaking, are much younger than the earth"[318]—and the prospects of life elsewhere—the Moon "in her stage of death"[319] no longer capable of supporting life, the young Jovian planets "getting towards that stage

---

315 Proctor, *Life and Death of a World*, 1880, p. 3.

316 Proctor, *Life and Death of a World*, 1880.

317 Proctor, *The Moon*, 1880.

318 Proctor, *Life and Death of a World*, 1880.

319 Proctor, *Life in Other Worlds than Ours*, 1880.

which will admit of supporting life"[320] (and which probably already had inhabited satellites). The theme is present in all of his lectures, but in particular this first one, "Life and Death of a World", as well as "Planets—Other Worlds than Ours" and "Birth and Growth of the Universe". That Proctor presented such a strong theme no doubt increased the memorability of Proctor's lectures. Certainly audiences easily perceived the theme.[321]

Following an extended discussion of cosmic evolution, Proctor turns to the question of the age of the earth. A subject of broad interest, for reasons scientific and non-scientific, Proctor is careful to establish claims of authority here. Here he, perhaps surprisingly, downplays the role of astronomy. Astronomers "have to be beholden to the geologist for such data as enable them to arrive at any satisfactory theory"[322] about this age. When it comes to the question of the future of the Earth, on the other hand, Proctor is keen to cite precedents from historical science to the theory of the gradual drying of the surface: "so far from being attributable to modern science, it owes its birth to Sir Isaac Newton".[323]

Proctor then applies his framework of cosmic evolution to the other planets in the solar system. He gives a simple physical analogy to demonstrate the slower rate of cooling for larger objects and states that this proves

> that the larger planets, scientifically speaking, are much younger than the earth, or, in other words, that the process of cooling have not become so matured, they are almost in their first stage of life; and according to the same reasoning, planets smaller than the earth are now in their old age, their decay, and decrepitude, and fast advancing to the stage of death.[324]

---

[320] Ibid.

[321] 'The Critic. Mr. R. A. Proctor as a Lecturer', *Australasian*, 5 Jun. 1880, p. 6.

[322] Proctor, *Life and Death of a World*, 1880, p. 4.

[323] Ibid., p. 6.

[324] Ibid.

This directness with which Proctor connects a simple everyday observation with his overarching framework—also readily grasped—is quite characteristic of his style.

After describing the planets of the solar system and returning to a description of the Earth, Proctor turns to "a planet in a more advanced stage, in that of decay and decrepitude", which is to say the Moon. This picture of the Earth's bleak future allows Proctor to present immediately before the conclusion of his lecture a climactic appeal to the sublime:

> You may imagine that the view that I have to-night submitted to you of the solar system is desolate and terror-striking, compared with the theories and assertions of Brewster and Chalmer; but although it may be desolate at first sight, it enables us to recognise the infinity of space. There are more than a hundred million stars visible through a single telescope, and each star is the centre of a solar system: supposing that life exists on one planet, in each system it must exist in a hundred millions of worlds. There must be hundreds of millions of worlds in all the stages of preparation, some emerging into life, others declining to decay and death. Life there has been for the infinite past, there will be life for the infinite future[325]

In this short passage, Proctor invokes almost all of the bases of the astronomical sublime—the destructive power of cosmic forces, the infinities of both space and time in the universe, the chances of a multiplicity of life forms elsewhere—and ties them all into his framework of cosmic evolution. Nor is it surprising that this rhetorical height is reached just before the end of the lecture; this is a repeated technique of Proctor's. In more than half of his lectures, including 'The Moon', 'The Star Depths' and 'Birth and Growth of the Universe' as well as this one, Proctor would finish with a description of the vastness or power of the Universe, and the implications these had for human's place on Earth. In 'The Star Depths' he would opine "from the darkness of death may come a new and grander life" while speaking about the Moon, Proctor would talk of a

[325] Ibid., p. 8.

> Solar System lost in a galaxy of beauty around us and that galaxy itself a mere speck in the infinity of space. We must also learn to look upon the history of this little world of ours as only a second in the history of the galaxy of which it is but one insignificant member; the entire duration of the Solar System lost in the history of the galaxy of which it is but one insignificant member; the entire duration of the Myriads of Stars around us but a moment in eternity[326]

One aspect of Proctor's theme of cosmic evolution that was discussed—but not emphasized—on his Australasian tour was his support for the nebular hypothesis of Laplace. One of the most long-running questions of nineteenth-century astronomy, this hypothesis was actually a series of related questions. Laplace's nebular hypothesis was that solar systems formed through the gravitational contraction of a gaseous substance, and this theory had a clear evolutionary interpretation. However it also depended on the factual supposition that such gaseous regions actually existed in space and, somewhat confusingly, this more restricted idea was also referred to as the nebular theory or hypothesis. Opinions on this latter question had themselves waxed and waned. The Orion and Trapezium nebulas were regarded as the prime examples of truly gaseous nebula, so the 1845 claims by Lord Rosse and James Robinson to have resolved them into clusters of individual stars was regarded as conclusive and for most of the next twenty years the nebular theory was regarded as disproved. However when Huggins showed in 1864 that the Orion nebula had the spectrum of a gas, the opinion of astronomers shifted even more quickly and decisively: gaseous nebulae existed. Proctor discussed these ideas only in his seventh and most infrequently delivered lecture "The Birth and Growth of the Universe". This matter had been followed as closely in Australia as elsewhere, and Proctor was well-known from his other writings as a supporter of the theory of Laplace[327] and his 1880 lectures would be interpreted by some in this regard even when he didn't explicitly introduce the subject.[328] Notably, the nebular theory and its former purported refutation were considered to be a point of attack against Proctor and his evolutionary framework.[329]

---

[326] Proctor, *The Moon*, 1880.

[327] 'Literature. Review', *Australian Town and Country Journal*, 15 Apr. 1876, p. 24.

[328] 'Mr Proctor's Lecture on the Moon', *South Australian Register*, 21 Jul. 1880, p. 6.

[329] 'The Nebular Hypothesis', *Port Adelaide News*, 4 May 1878, p. 4.

3.2.4 Literary allusion

The ending of 'The Life and Death of a World', completing the rhetorical climax, was a slight paraphrase of a quote from 'Dream Upon the Universe' by German Romantic Author Jean Paul Friederich Richter: "End there is none to the universe of God; lo, also there is no beginning". This particular quotation was particularly noted.[330]

The technique of literary allusion was also frequently employed by Proctor. Other references in Proctor's lectures include an illustration from Thackeray's novel *Vanity Fair* in order to illustrate the uncertainties in the measurements taken by the transit of Venus in his lecture on the Sun, and lines from the American spiritualist Elizabeth Doten's poem 'Reconciliation' to conclude his lecture on life in 'Other Worlds than Ours':

> God of the Granite and the Rose!
> Soul of the Sparrow and the Bee!
> The mighty tide of Being flows
> Through countless channels, Lord, from thee.[331]

Although on occasion Proctor had been "criticised for coupling astronomy with poetry"[332] this particular technique clearly fulfilled important purposes for him. It showed Proctor to be a well-educated man, and a generalist beyond the narrow confines of his specialisation. It also spoke to his audience, which was projected as a particular class of listener equally well-educated in literary matters. In particular it served to present astronomy as a part of the intellectual life of all of the members of that community rather than being the province only of specialists. This is an example of the expansive construction of meaning within popular science. Popularization is most successful when it is able to connect with people's lived experiences, and so makes connections between technical claims of science and other aspects of culture. Cultural schemata act to interpret scientific claims in the light of other meanings. As will be discussed in § 5.2, they also simplify cognitive burdens.

[330] 'Richter's Dream of the Universe', *Western Star and Roma Advertiser*, 22 Sep. 1880, p. 3.

[331] Doten, *Poems from the Inner Life*, 1863, p. 53; Proctor, *Life in Other Worlds than Ours*, 1880, p. 7.

[332] 'News from the Sun', *Brisbane Courier*, 6 Sep. 1882, p. 2.

3.3: Techniques in subsequent lectures

Proctor's first and most commonly delivered lecture, 'The Life and Death of a World' shows many of the specific techniques that he would repeat throughout other lectures. However there are some of his techniques that are more subtle in this lecture and best shown by examples from his subsequent lectures.

3.3.1 Cultural schema of astronomy: The plurality of worlds

Proctor's breakthrough success of 1870, *Other Worlds than Ours*, concerned the 'plurality of worlds' debate, that is the question as to whether there were other planets in the Universe that were inhabited. Unsurprisingly, it also formed the subject on one of his lectures on tour. Although, as Proctor noted, it is not strictly a question of astronomical science,[333] nonetheless it has been one of the most prominent cultural schema of astronomy from ancient times, through the nineteenth century with authors like Flammarion and Proctor, right up until today.

Speculations about the plurality of worlds had a long history. They arose in ancient times, with Democritus, Epicurus, Diogenes and Lucretius being just some of the Greek philosophers who argued for an infinite universe with infinite worlds. Against them was set the authority of Aristotle who argued on physical and metaphysical grounds for one

[333] Proctor, *Life in Other Worlds than Ours*, 1880, p. 3.

Earth. One of his key arguments was that an infinite universe could not rotate and since the stars did, they could not be infinite.[334]

It was the latter opinion that proved dominant for Christian writers such as Augustine in particular, and there was little discussion of plurality of worlds until the thirteenth century. At this time, the ancient ideas started to be discussed again and a number of Christian viewpoints emerged. Some, most famously Giordano Bruno, argued that God's creativity was infinite and thus it was fitting for there to be an infinity of worlds. Against this was the notion that Christ's redemption was singular, and thus there could be only one world of men.[335] (This was the same argument deployed against the possibility of the antipodes being inhabited; clearly if half of the Earth could not be populated, distant worlds could not either.)

In the late sixteenth and early seventeenth century the rise of telescopic astronomy and the Copernican system had significant influence on this debate. The number of stars was revealed to be vastly greater than previously suspected, the other objects in our solar system were seen to be far more like our own world than had been realized, and the realisation that it was indeed the Earth that rotated, and not the sphere of stars destroyed one of the key Aristotelian justification for the finite universe. In this context, theological justifications came to have an even greater prominence, both for and against the doctrine.

The conception of the nature of space of the universe changed also. For some ancient thinkers like Epicurus, each world stood as

[334] McColley, 'The Seventeenth-Century Doctrine of a Plurality of Worlds', *Annals of Science*, 1936, 385–430.

[335] Ibid.

> a circumscribed portion of the universe, which contains stars and earth and all other visible things, cut off from the infinite, and terminating in a boundary which may be either thick or thin[336]

This notion of the worlds as being utterly separated from each other persisted all the way through to Descartes, with his vortical model of the Universe wherein each solar system is a slef-contained rotating 'vortex' of matter, disconnected from neighbouring vortices.

The plurality of worlds is strongly connected to the sense of the astronomical sublime. In particular, the imagined presence or absence of other living worlds informs peoples' understandings of themselves, as either unique creatures or part of an innumerable array. This cultural schema connects astronomy with people's lived experience by suggesting an insight into the human condition through a consideration of what is possible for life elsewhere, and hence the possibilities for our own lives.

It is difficult to overstate the importance of this schema for popular science. As noted, both Proctor and Flammarion achieved their success through this theme, and popular astronomers would continue to draw upon it for many decades to come. Although detailed interpretations would shift over time, the overall combination of imaginative, philosophical and religious meanings would prove useful to popularizers for a very long time.

3.3.2 Contemporary science

A number of these techniques had the function of enhancing Proctor's authority. One such was Proctor's invocation of contemporary science. Showing himself to be in full

[336] Laertius and Hicks, *Lives of Eminent Philosophers*, 1925, p. 517.

command of Baedeker's spectral analysis of comets[337] (a subject of considerable contemporary interest, as discussed in §2.5.1), Herschel and Rosse's measurements of the temperature of the Moon,[338] or even the analogies used by Professor Mundenhall[339] (in which the Colubia University astronomer calculated the time it would take for a nerve signal to travel from the Sun to the Earth if there were an arm that could stretch across that distance, described on the following page) demonstrates that Proctor is familiar with the full range of astronomical science and scientists. Not that Proctor always cites contemporary astronomers approvingly; Proctor is quite prepared to criticise his contemporaries in public lectures: Thomson is wrong about the heat source for the Sun,[340] both Brewster and Whewell are wrong about life on other planets;[341] Tait and Tyndall are wrong about the nature of comets.[342]

3.3.3 Striking numbers and familiar metaphors

A minor technique—but common to this time period, and indeed, ever since—used by Proctor was his command over the striking number. The Sun was once thought to be "95,365,000 miles away, it has a surface area 11,700 times that of the Earth, and it generates energy equivalent to 11,000 millions of millions tons of coal every second".[343]

The instant recall of such numbers are designed to impress upon his audiences his mastery of his subject. Specific numbers gave verisimilitude while large numbers provide

[337] Proctor, *Comets and Meteors*, 1880, p. 6.

[338] Proctor, *The Moon*, 1880, p. 5.

[339] Proctor, *The Sun*, 1880, p. 5.

[340] Ibid., p. 7.

[341] Proctor, *Life in Other Worlds than Ours*, 1880, p. 5.

[342] Proctor, *Comets and Meteors*, 1880, p. 5.

[343] Proctor, *The Sun*, 1880, pp. 4, 6, 7.

the effect of awe. It is worth noting that this deployment of large numbers was extremely common technique in scientific popularization in Proctor's time,[344] and is only slightly less common today.

This technique was effective but it would also emphasize the difference between Proctor and his auditors. Other techniques would reduce this difference. Counterposed to the use of the striking number was Proctor's use of familiar metaphors. The cooling of iron globes in 'The Life and Death of a World' was one such, albeit not especially quotidian. A more characteristic example comes in Proctor's lecture on 'The Sun' when he compares the length of time it would take for light to reach the Earth to the time it would take for a nerve impulse to travel that same distance.

> If a child were born with an arm 93,000,000 of miles in length, and at the moment of its birth it touched the Sun with the tips of its fingers, it would have to grow to the age of 132 years before it would become conscious, that it had burned its fingers the day of its birth.[345]

While based around a striking number, this metaphor is expressed in terms that all could understand (even if the assumptions underlying the calculation were anything but self-evident).

[344] eg 'Scientific, and Useful. Kernels', *Australian Town and Country Journal*, 28 Jun. 1890, p. 27.

[345] Proctor, *The Sun*, 1880, p. 5.

3.3.4 Relationship with audiences

Another technique used to reduce the distance between Proctor and his audiences was his use of local references. In Australia, Proctor was careful to make reference to local astronomers including Ellery, Russell and Tebbutt, for their lunar photography, transit measurements and cometary discoveries respectively.[346]

A final aspect of Proctor's technique, rather than building his personal authority, was to exploit it. Primarily this was to advance his own theories in the court of public opinion. The framework of cosmic evolution has already been described in detail, but there are other more technical theories that Proctor promoted as well. Of these theories, the most notable are his ideas about the nature of the Sun, and of the consequences of meteoric impacts thereon, subjects that would recur throughout his Australasian tour and after.[347]

The final textual technique that will be mentioned here is Proctor's frequent allusions to debates over religiosity and secularism, invoking the prospect of solar worship in his lecture on the Sun or dismissing the need for divine intervention in creating the synchronicity of the Moon.[348] Given how readily Proctor's audiences discerned religious connotations from his lectures, and how central religious disputation became to his reputation, it is perhaps surprising on first reading how *in*frequently Proctor makes direct references to religion. It would seem that he was sufficiently skilled in his communications to ensure that his allusions were sufficient.

[346] Proctor, *The Moon*, 1880, p. 6; Proctor, *The Sun*, 1880, p. 4; Proctor, *Comets and Meteors*, 1880, p. 6.

[347] Proctor, *The Sun*, 1880, p. 7; Proctor, *Comets and Meteors*, 1880, p. 7.

[348] Proctor, *The Sun*, 1880, p. 3; Proctor, *The Moon*, 1880, p. 6.

3.4: Proctor's success: Visual communication and controversy

A central technique of Proctor's that was certainly employed in 'The Life and Death of a World' but which is not evident from the written transcript is his visual communication. In a typical lecture Proctor would show 50 or 60 images.[349] Proctor evidently spoke to these views to the extent that the *Argus* notes that their lecture transcript, omitting these descriptions, "would only represent in volume, about one third of the total quantity"[350] of material presented in the lecture. Audience members frequently referred to the appeal of the illuminated views. These images included photographs, spectrographs and illustrations such Nasmyth's images of the Moon's surface (Figure 3.2). Proctor also travelled with a set of large maps of the Sun, the Moon, and the planets which he could rely upon if no other visual aids were available.[351] In his Australasian tour he needed to call on them only in his first lectures in Melbourne and in Geelong.[352] After that he preferred his personal collection of lantern slides. Some of the visual heritage Proctor drew on was discussed in Chapter 2, these visual and material practices will be discussed in more detail in Chapter 4.

Proctor's visual communication reinforced his deliberate frameworks. Proctor deployed Nasmyth's images, for example, to underline his framework of cosmic evolution. Figure 3.3 shows one of the images from Nasmyth's book that was used by Proctor: the

[349] 'Lectures', *Newcastle Morning Herald*, 10 Sep. 1880, p. 1; 'Prof. Proctor in Boston', *New York Tribune*, 8 Nov. 1875, p. 1; 'News of the Day', *Age*, 29 Jun. 1880, p. 2.

[350] 'Mr. Proctor's Astronomical Lectures', *Argus*, 28 May 1880, p. 6.

[351] '(No Title)', *Wairarapa Daily Herald*, Nov. 1880, p. 2.

[352] 'Mr. Proctor's Astronomical Lectures', *Argus*, 28 May 1880, p. 6.

photograph image of a wrinkled hand next to a withered apple. This juxtaposition was intended to suggest, by visual analogy, that mountains could be caused by shrinking, supporting Proctor's theory that the Moon was an old world no longer capable of supporting life. This evocative image was particularly noted by a number of reviewers.

This visual communication had many other functions than immediate gratification: they demonstrated that his knowledge was up-to-date, reinforced the associations between astronomy and cosmic order, and provided assurances to his audience about the non-technical orientation of his lectures. In New Zealand, it was also used to generate a new audience; in his children's show 'Other Worlds and Other Suns', presented only in Dunedin and Wellington and focussing more on the images themselves, he would display 80 images.[353] In view of Proctor's freethought associations, it is notable that Dunedin, would shortly after Proctor's tour become home to the colony's most thriving freethought children's lyceum.[354]

Visual techniques were a main way in which Proctor ensured the inclusion of local content. One such was a slide of a lunar photograph from the Melbourne Observatory. (Figure 3.4) They also allowed him to utilise his reputation with local astronomers; Proctor displayed his slides through a lantern borrowed—at short notice—from Robert Ellery of the Melbourne Observatory. Figure 3.5 depicts Richard Proctor lecturing at the Melbourne Athenaeum, the venue for his Melbourne lectures (the new hall of the Athenaeum at that time being managed by Smythe). At the rear of the image the lanternist bears a strong resemblance to Government Astronomer Robert Ellery. No records exist to show who actually operated the lantern on this night; the illustrator may have wished to merely indicate the connection, or to show the local representative of astronomy. In any case, Proctor's use of the Observatory lantern indicates the importance with which he was regarded by local astronomers. These astronomers certainly showed interest in Proctor, both at a professional and a personal level; before he arrived in

[353] 'Amusements', *Otago Daily Times*, 21 Oct. 1880, p. 1.

[354] Lineham, 'Freethinkers in 19th Century New Zealand', *New Zealand Journal of History*, 1985, 61–81.

Adelaide the South Australian Government Astronomer Charles Todd would ask Ellery "Is he a friendly fellow?"[355]

Yet another, and maybe the main, aspect of Proctor's success was his ability to manage controversy. More than once Proctor was described as sensationalist but even some of these critics understood that this sensationalism was a part of his success.[356] Proctor asserted that he "never attempted any approach to oratory" because "it does not befit the lecturer on so noble a subject to intrude his petty personality between that subject and his audience"[357] but he is 'protesting too much'. Proctor certainly injected his own position into his lectures, as described with his framework of cosmic evolution. Another of his own theories that he would highlight was the danger to life on Earth from cometary impacts on the Sun. Nor was he afraid to make specific criticisms of other scientists or to shy from subjects with marginal scientific support, such as his speculations about the prospects of life on other planets throughout the solar system. This role of popularization as presenting as informative but acting as persuasive communication will be explored further in Chapter 5.

The Melbourne Observatory lantern not only reflected Proctor's ability to draw on the resources of the local astronomical community, it also provided the first such controversy of Proctor's tour. Finding it unexpectedly difficult to engage a lanternist cheaply in Melbourne, he borrowed the lantern from Ellery just before his second lecture. The haste with which this lantern was arranged caused several problems. It was unable to magnify his slides to the size he wished—25 feet across. Even worse, in the rush to set up the lantern the two gas tubes—oxygen and hydrogen—were accidently swapped. As a result on the second night the images were dim and on the third the hydrogen ran out: several illustrations had to be omitted.

355 Todd, 'Letter Todd to Ellery, June 1880', 1880.

356 Benvie, 'A Few Thoughts on Current Speculations', *Maitland Mercury and Hunter River General Advertiser*, 11 Sep. 1880, p. 7; 'Victorian Churches and Preachers', *Weekly Times*, 24 Apr. 1886, p. 7.

357 Proctor, 'Mr Proctor's Farewell', *Argus*, Jan. 1881, p. 7.

One image left out was a chart of the surface of Mars, similar to the picture in Figure 3.6, the map of Mars from Proctor's *Other Worlds than Ours*. This was Proctor's most well-known book, and the mapping of Mars one of his particular areas of scientific expertise. It was important for Proctor for reasons beyond mere curiosity; it was central both to his personal claims for authority and to advance his thesis of cosmic evolution. Lightman has described how the naming and representation of features on Mars was a key technique by which Proctor established Mars—and by inference other planets—as a world similar to Earth but at a different stage.[358] The omission of this image was more than a minor inconvenience.

Proctor attempted to deflect attention from the failure of the lantern equipment. He flattered Melbourne audiences for their attention span but tried to distance himself from the problems with the lantern. In particular he complained that Melbourne was an unusually difficult city in which to find competent lanternists.[359] A Melbourne maker of optical instruments, and lanternist, W Wood, took offence at this slur and a brief exchange of letters appeared in the *Argus*. [360]Wood noted errors that had been made in setting up the lantern. The screen had been dampened—a technique that was useful only for rear-projection, not the front-projection in operation here. Wood also commented upon Proctor's behaviour, and suggested that Proctor had been less than honest in his account of his negotiations. Proctor and Smythe quickly called on Wood and the matter was smoothed over.

The lantern from Ellery would remain with Proctor for the rest of his tour,[361] although when oxygen and hydrogen were not available he was forced to rely on other illuminants such as kerosene.[362] The pattern observed in this public argument would be seen more

[358] Lightman, 'The Visual Theology of Victorian Popularizers of Science', *Isis*, 2000, 651–80.

[359] '(No Title)', *Argus*, Apr. 1880, p. 5; 'Mr. Proctor's Astronomical Lectures', *Argus*, 28 May 1880, p. 6.

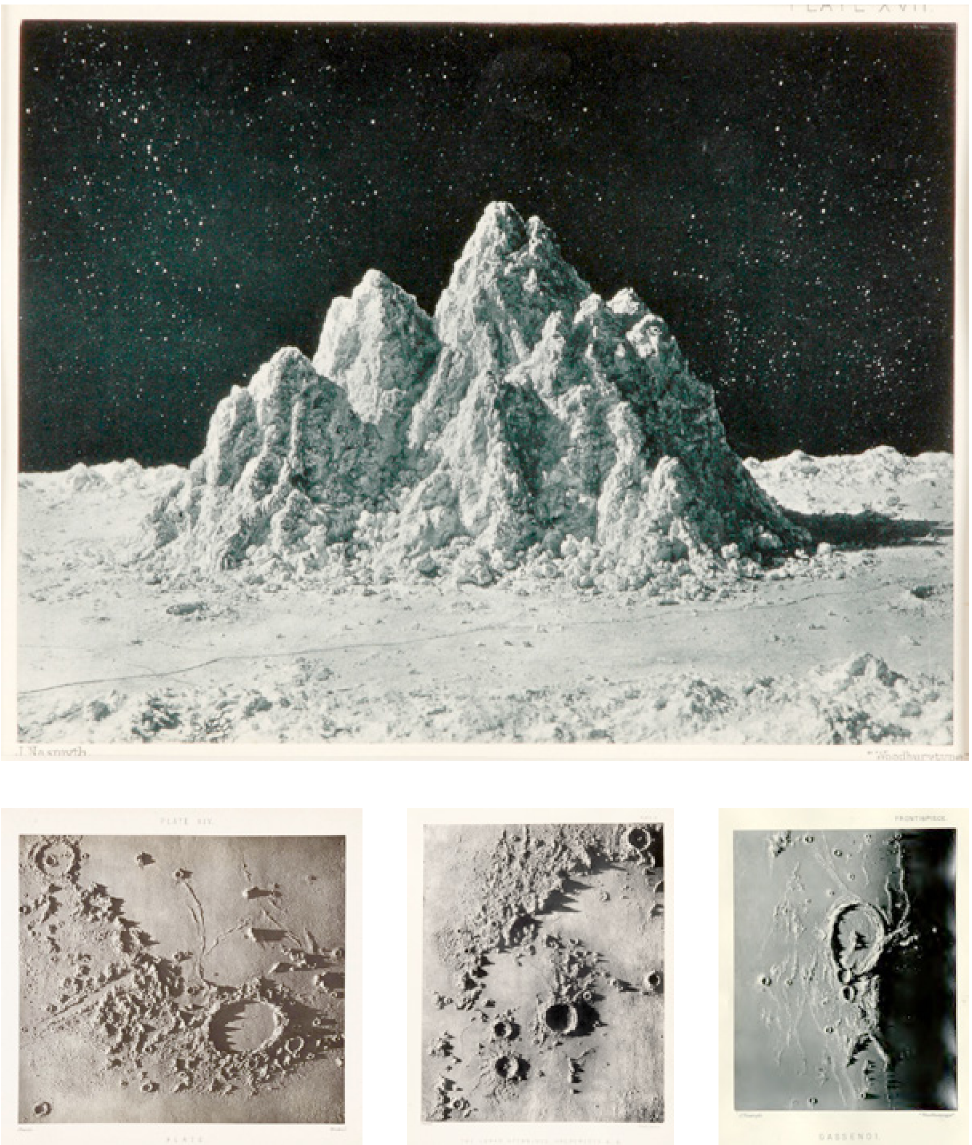
[360] Wood, 'Mr. Proctor's Lectures', *Argus*, 11 Jun. 1880, p. 3; Proctor, 'Mr. Proctor's Lectures', *Argus*, 12 Jun. 1880, p. 8; Wood, 'Mr. Proctor's Lectures', *Argus*, 16 Jun. 1880, p. 7.

[361] 'New Advertisements', *Marlborough Express*, 23 Nov. 1880, p. 3.

[362] 'Provincial Telegrams', *Evening Journal*, 30 Jul. 1880, p. 2.

than once over the course of the tour: Proctor sensitive to any implied slight to his competence and professionalism and quick to respond condescendingly but Proctor and Smythe also both quick to be diplomatic in an effort to resolve matters. Later disputes would not prove as tractable as this one.

The role of controversy was also paramount to the success of Proctor's tour. These later, and ongoing, controversies would feed off Proctor's prior reputation. I will thus give a brief description of that.



Source: Internet Archive

Figure 3.2 Images from Nasmyth's *The Moon*

This image representing the lunar surface is taken from James Nasmyth's 1874 book *The Moon Considered as a Planet, a World and a Satellite*. Nasmyth painstakingly modelled the lunar surface with plaster models, square, approximately half a metre across. The top image gives a side-on picture of one of these models although most of the images in the book were like the smaller images: photographed from above, and lit carefully to replicate telescopic views as accurately as possible.

These images were some of the most advanced astronomical visualizations of the time. Despite knowing that they were entirely artificial, many leading astronomers regarded them as being extremely authentic. Richard Proctor included images from Nasmyth's book in his lectures, enhancing his association with up-to-date techniques.

Source: Internet Archive

Figure 3.3 Nasmyth's image of a hand and an apple

A particularly evocative image from James Nasmyth's *The Moon* was his comparison between a withered apple and an elderly person's hands. This was intended to show that wrinkles, and mountain ranges, could be caused by shrinkage. This persuasive aspect of popular science shows continuity with similar forms of persuasive techniques in scientific texts because popular science is, in fact, continuous with 'core' scientific work. Nonetheless it stands in stark contrast to the public image promoted by many popularizers themselves.

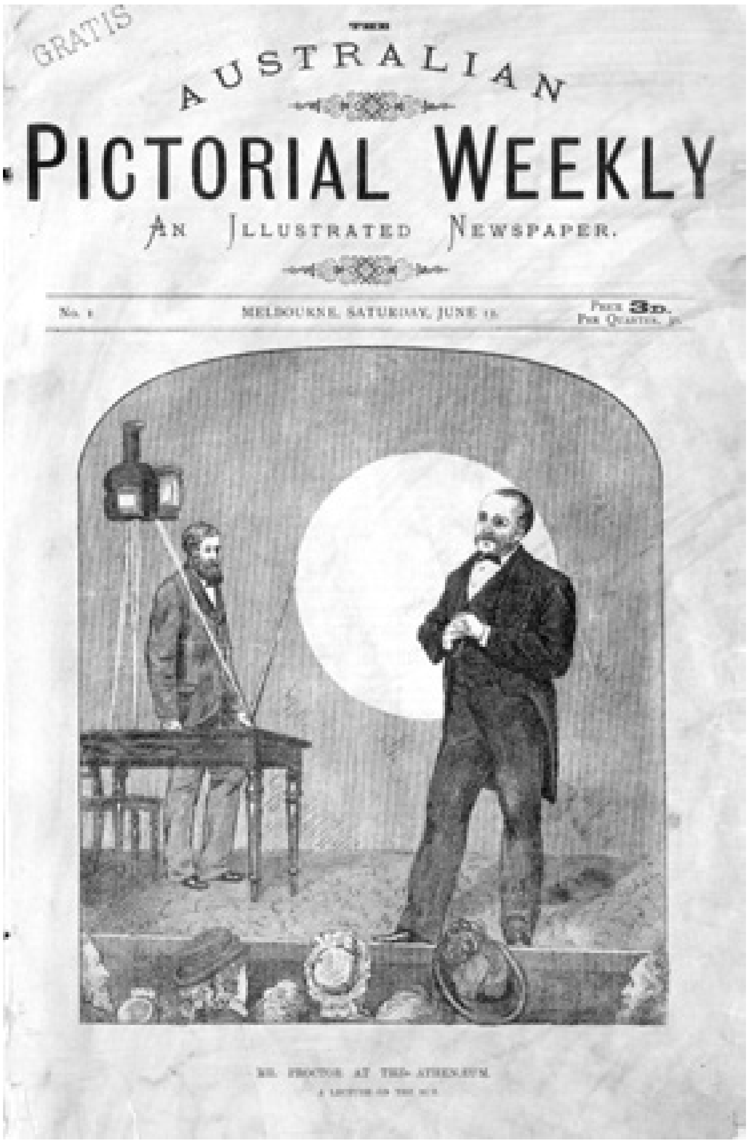
In this case, Nasmyth intended his book to promote the theory for the volcanic origin of lunar craters. Proctor advocated an impact theory but found this image useful anyway, in order to promote his theory of the Moon as an old world.

Source: Museum Victoria MM 39860

Figure 3.4 Photograph of the Moon from the Melbourne Observatory, 1872

Proctor was a very successful communicator, and one of his techniques was to make connections with his local audiences. In particular he was careful to make reference to local scientists in his presentations. This photograph of the Moon taken by the Melbourne Observatory was used by Proctor throughout his tour of Australia and New Zealand. Use of the photograph also enhanced Proctor's association with up-to-date visualizations as astrophotography was still a growing field at the time.

Proctor was by no means alone in using these techniques. The same image had earlier been used by Professor Pepper for similar reasons.

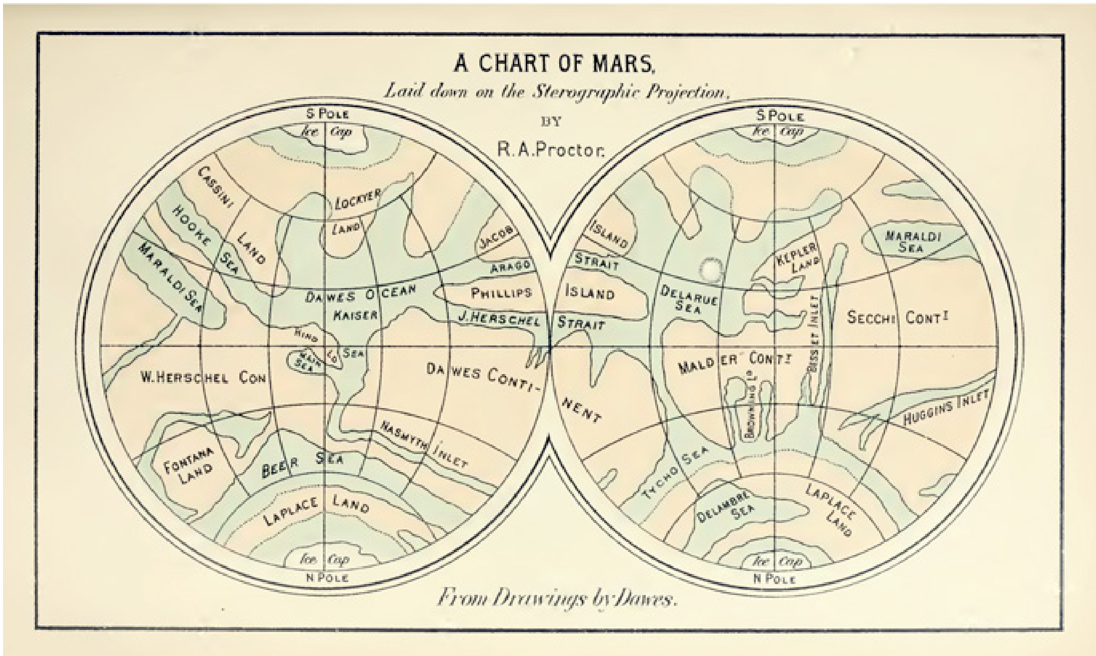


Source: State Library of Victoria

Figure 3.5 Richard Proctor, portrayed on the cover of the *Australian Pictorial Weekly,* 1880

The front cover of the *Australian Pictorial Weekly*, 12 June 1880, shows Richard Proctor delivering his lecture on the Sun at the Melbourne Athenaeum on 1 June 1880.

A number of things are conspicuous in this picture. The magic lantern has a prominent position. The lanternist pictured bears a striking resemblance to Melbourne Observatory astronomer Robert Ellery, from whom the lantern was borrowed, although no records exist to show who operated the lantern on this evening. The number of women present in the front row is also notable—public lectures in general, and astronomy in particular, often attracted many women. This latter point is not always clear from newspaper reports, showing both the limitations of that source of evidence and the value of images.



Source: Internet Archive

Figure 3.6 Richard Proctor’s map of Mars

One of Richard Proctor’s astronomical specialities was mapping the surface of Mars. This map was initially drawn by William Dawes, but was adapted by Proctor, who renamed its features. Moreover, the names were specifically assigned in order to reinforce Proctor’s theory of Mars as an ‘old world’, reinforcing the persuasive aspects of visual communication within popular science. Proctor published the adapted map and used it in his lecturing.

This image had to be omitted from Richard Proctor’s third lecture in Melbourne. A mistake was made setting up the gas tubes for the hastily borrowed lantern, meaning that the hydrogen ran out. Given the importance of this map to Proctor’s authority, this omission was more than a minor inconvenience.

3.5: Proctor's reputation before arriving

Although Richard Proctor's success was not assured, his tour of Australia and New Zealand started with some clear advantages. The English astronomer was the most well-known popularizer of his time. He was a prolific writer and energetic lecturer with a global following. Over his career he published hundreds of essays throughout the Anglosphere, his books sold even more widely, and he delivered thousands of lectures in Britain, the USA, and then Australia and New Zealand.[363]

Proctor was certainly well-known to Australian audiences long before his 1880 tour. He had come to the attention of the readers of colonial publications early in his career as a writer. Despite his success this career was marked by disruption, dispute, and uncertainty. Originally intending to train as an Anglican priest, Proctor's entry to Kings College was delayed by the death of his father. Eventually, as planned, he moved to Cambridge, but then a combination of his marriage and the death of his mother turned him away from the Anglican priesthood to studying law. He switched his intended profession again, to astronomy, upon the death of his eldest son in 1863; Proctor's physician had advised him to throw himself into some work. Proctor took popularization seriously after the New Zealand Banking Corporation collapsed in 1866, taking with it the bulk of what remained of his inheritance.[364] His breakthrough success of *Other Worlds Than Ours* in 1870, and a break with the Royal Astronomical Society in 1873 led him to set aside his research astronomy for a full-time career in popularization.

[363] Lightman, 'Marketing Knowledge for the General Reader: Victorian Popularizers of Science', *Endeavour*, 2000, 100–106.

[364] Saum, 'The Proctor Interlude in St. Joseph and in America: Astronomy, Romance and Tragedy', *American Studies International*, 1999, 34–54.

It was another death—his wife—that facilitated Proctor's Australian tour. Mary and Richard Proctor had already considered a trip to Australia in order to improve her health. After Mary's death, Proctor was introduced to Smythe in London by Frederick William Haddon,[365] editor of the *Argus,* the newspaper which was "the voice of Victorian conservatism".[366] From this meeting Proctor planned a commercial lecturing trip to Australia, to follow on immediately from a tour of the United States.[367]

Proctor's earlier split with the astronomical establishment casts light on the development of Proctor's individual career. It also illuminates the processes associated with the professionalization of science in the late nineteenth and early twentieth centuries and, more importantly for this thesis, the way that these disputes were to a significant degree fought in the public domain. As Nall notes, in terms of his "imaginative" astronomy", Proctor's public writing was central not just to his own professional identity, but to the progress of astronomy in the late nineteenth-century:

> With a range of astronomies apparently viable, Proctor's imaginative astronomy successfully posited that science journalism represented the most fruitful and likely way for the discipline to progress beyond its profound identity crisis.[368]

Proctor had initially clashed with the astronomer Norman Lockyer, who would go on to found the journal *Nature*, over an aspect of solar physics, but the antagonism was brought to a head over the question of the scientific organization of research expeditions. Proctor had suggested tests that eclipse watchers could perform to help resolve the dispute between himself and Lockyer. As larger and more expensive expeditions were mounted, and financed, Proctor grew increasingly frustrated with Astronomer Royal George Airy's

[365] Woods, 'Haddon, Frederick William (1839–1906)'.

[366] Murray and Usher, 'Argus', 2014, pp. 24–25.

[367] 'Death of Mr. R. S. Smythe', *Argus*, 24 May 1917, p. 6.

[368] Nall, 'News from Mars', PhD thesis, 2013, p. 61.

management of them. Proctor felt that Airy had made significant organizational blunders, but that there was no one under Airy who would dare challenge him and no one above Airy who would understand. Such lack of accountability was, for Proctor, anathema to both the scientific enterprise and good governance. Proctor himself publicly criticised Airy including through letters to newspapers, showing the permeable boundaries between scientific, government and public audiences. This challenge to the Astronomer Royal's authority—doubtless added to his long-standing enmity with Lockyer—led him to resign as one of the Honorary Secretaries of the British Astronomical Society. Proctor increasingly came to feel that government support for scientific research, while admirable in principle, inevitably led to corruption in practice; he felt that scientists should be more entrepreneurial and be able to live off their public writing as he, and a few other scientists like Thomas Huxley—'Darwin's bulldog'—could do.[369]

The first of Proctor's writings to be noticed in Australia was an article of his in *Fraser's Magazine* on the Orion nebula, which was discussed in the *Australasian* of 2 May 1868. Later that year another article of his from *Fraser's Magazine* would be reprinted in whole.[370] This publicity clearly had an effect; by the next year Proctor's books were being advertised for sale in a number of newspapers.[371]

Proctor would be a particular favourite of the *Australasian* over the next twelve years. The newspaper reviewed his books and reprinted many of his *Fraser's Magazine* and *Cornhill Magazine* articles.[372] It is worth noting that, despite its political conservatism, the editorial position of the *Australasian* had been decidedly in favour of Darwinian

[369] Lightman, *Victorian Popularizers of Science*, 2009.

[370] Proctor, 'Scientific. Lands and Seas of Another World', *Australasian*, 31 Oct. 1868, pp. 6–7.

[371] 'Advertising', *Sydney Morning Herald*, 27 Apr. 1869, p. 6; 'Classified Advertising', *Brisbane Courier*, 25 Sep. 1869, p. 1.

[372] 'Scientific. The Dog Star and His System', *Australasian*, 3 Jun. 1876, p. 6; 'Literature. Pleasant Ways in Science', *Australasian*, 22 Feb. 1879, p. 8; Proctor, 'Scientific. Planetary Suns', *Australasian*, 27 Jul. 1872, p. 6; Proctor, 'Scientific. The Asteroids and Their Lessons', *Australasian*, 13 Apr. 1878, p. 7.

evolution, in contrast with local rival the *Age* which had struck a more oppositional tone. This broader context will be discussed in Chapter 5.

One article of Proctor's that was particularly noted by the Australian press was his claim in *Belgravia* of March 1877 that a cometary impact with the sun could destroy all life on Earth. Given both the apocalyptic nature of this claim, and the widespread Australian interest in comets described in Chapter 2 it is no surprise that this was of interest. Furthermore, Proctor would continue his speculations about cometary impacts throughout his career. This is detailed further in the next section.

Finally, from August 1879 until the tour itself, Proctor contributed an original column, 'Popular Science', to the *Australasian*, almost certainly another outcome of his meeting with editor Haddon in London.[373] The first of these concentrated on astronomical topics, such as spectroscopy of the Sun, an interest that would run throughout, but he soon branched out into other areas of science as well, including physiology and meteorology.[374] These columns showed many of the techniques that Proctor would express in person, such as a direct appeal to his Australian audiences—and a willingness to criticise scientific colleagues, such as fellow astronomer Piazzi Smyth.[375] His favourite theme of cosmic evolution would not be overlooked.[376] A number of these were evidently written before he left England,[377] while later columns were contributed while on his American tour.[378] Proctor reworked his writing many times, publishing similar columns in multiple newspapers, and then republishing them in his books, but he also wrote prolifically,

[373] No archival evidence has been found but the timing leaves little doubt.

[374] Proctor, 'Scientific. Popular Science', *Australasian*, 16 Aug. 1879, p. 8; Proctor, 'Scientific. Popular Science', *Australasian*, 30 Aug. 1879, p. 8; Proctor, 'Scientific. Popular Science', *Australasian*, 20 Sep. 1879, p. 6.

[375] Proctor, 'Scientific. Popular Science', *Australasian*, 30 Aug. 1879, p. 8.

[376] Proctor, 'Scientific. Popular Science', *Australasian*, 6 Mar. 1880, p. 7.

[377] Proctor, 'Scientific. Popular Science', *Australasian*, 20 Sep. 1879, p. 6.

[378] Proctor, 'Scientific. Popular Science', *Australasian*, 28 Feb. 1880, p. 7.

reportedly for hours every night. His manager in the USA, Charles Carter was reported as saying that

> during the tour Proctor would often seclude himself for an hour and a half before dinner and come down from his room fresh and smiling with—"Well, Carter, I've earned fifty dollars—here's another article."[379]

His *Australasian* columns written in the USA also included more commentary on reports appearing on other publications, presumably an easy way to fill column space while on tour. The last column appeared on 5 June 1880, just after the commencement of his Australian tour. It was somewhat of a miscellany, although it did note Proctor's desire to observe zodiacal lights while on the ship to Australia.[380]

Proctor was also involved directly and indirectly in a number of local astronomical matters. The first and most significant[381] of these concerned the Tasmanian amateur astronomer Francis Abbott and the nebula Eta Argus (now known as Eta Carinae). This was a significant astronomical object at the time. The physical nature of nebulae was one of the biggest questions in nineteenth century astronomy, as described in § 3.2.3, and Eta Argus was one of the most interesting of the nebulae for astronomers. Inaccessible to northern telescopes, its study was of particular significance to southern hemisphere astronomy. Nebular theory was one of the great developments of nineteenth century astronomy and the questions as to whether nebulae were all of the same kind and how they were related to ordinary stars were some of its great controversies. These subjects would appear in popular astronomy as well.

Abbott was particularly fascinated with Eta Argus and spent much of his astronomical career observing it. He came to believe that the nebula had changed considerably in

[379] 'Richard Anthony Proctor', *South Australian Advertiser*, 9 Jul. 1880, p. 6.

[380] Proctor, 'Scientific. Popular Science', *Australasian*, 5 Jun. 1880, p. 8.

[381] As noted above, this incident *has* been treated in histories of Australian astronomy.

appearance since it had been drawn by John Herschel at the Cape of Good Hope in 1838. Throughout the 1860s Abbott communicated his findings to the British Astronomical Society. These reports attracted the notice of the British astronomical community and things came to a head in 1868 when Abbott produced not just a report but a drawing of his observations[382] This drawing, shown in Figure 3.7 was scrutinised by Sir John Herschel himself who published a condescending report in the next issue of the Society's *Monthly Notices*: Abbott had drawn star locations wrongly; used non-standard terminology; was unclear about the orientation of the diagram and had improperly specified the settings of his telescope.[383] These all suggested to Herschel that Abbott had simply misunderstood what he had been looking at. Richard Proctor picked up on this dispute and published an article in *Fraser's Magazine*, taking Herschel's side.[384] (This article would be substantially republished in Proctor's book *Universe of Suns* in 1884, after Abbott had died.) When Abbott appealed directly to Proctor for an opinion in 1871 Proctor backed the judgement of Herschel even more strongly: Abbott was an incompetent observer.[385] The Astronomer Royal Airy provided a third opinion that was scathing of the quality of Abbott's drawings. Although Airy conceded that some of Abbott's claims were very likely correct, nonetheless Abbott's reputation in Europe had been shredded. He ceased publishing in the major journals although he continued to put his claims before the Royal Society of Tasmania.[386]

This incident was one of the clearest assertions of the authority of professional astronomers over amateurs in the mid-19th century, and Proctor lent his growing popular status to the cause of professional astronomy. Yet he did so eclectically. Proctor both

[382] Abbott, 'On the Variability of Eta Argus and Surrounding Nebulae', *Monthly Notices of the Royal Astronomical Society*, 1868, 200–202.

[383] Herschel, 'On the Variable Star Eta Argus and Its Surrounding Nebula', *Monthly Notices of the Royal Astronomical Society*, 1868, 225–29.

[384] Proctor, 'The Great Nebula in Argo', *Fraser's Magazine*, Dec. 1868, pp. 762–68.

[385] Proctor, 'Note on Mr. Abbott's Imagined Discovery of Great Changes in the Argo Nebula', *Monthly Notices of the Royal Astronomical Society*, 1871, 62–64.

[386] Orchiston, 'The Contribution of Francis Abbott to Tasmanian and Australian Astronomy', *Vistas in Astronomy*, 1992, 315–44.

argued for the authority and autonomy of specialist astronomers while opposing institutional science. He broke with the British astronomical society after charging the Astronomer Royal with misusing his power to stifle dissent. Throughout his life Proctor argued for the priority of professional judgement but he felt this to be legitimate only as the expression of an individual, and not as a judgement of institutions.

Around the same time, in 1870, Proctor was drawn into another local controversy, this time unwittingly. The amateur astronomer (and popular science lecturer) Henry Severn waged a campaign against the design of the Great Melbourne Telescope and its astronomer Albert Le Sueur, initially through letters to the *Argus* and culminating in a scathing paper read at a meeting of the Royal Society of Victoria.[387] One of the pieces of evidence Severn tendered was Proctor's opinion of the respective merits of reflector telescopes (like the GMT) and refractors (such as Severn advocated). Although Proctor doubtless intended no disrespect to the GMT—and was certainly complimentary of the Melbourne Observatory on his visit a decade later—nonetheless his name was invoked more than once throughout this dispute as Severn, and Le Sueur and Ellery on behalf of the Observatory, traded barbs through the press.

A more minor dispute occurred on the eve of the tour itself. It was reported that New South Wales Government Astronomer Henry Chamberlain Russell had agreed with an assistant's claim to have observed the shadow of a comet on the Moon. Proctor said that such a notion was ridiculous; the observation was a natural shading on the surface. A number of Australians in London took offence on Russell's behalf and claimed that he had been misunderstood. Russell himself wrote to *The Observatory* to complain about Proctor's article.[388] As with the subsequent lantern dispute Proctor was initially brusque, but soon apologised. By the time he arrived in New South Wales no ill feeling was evident between Proctor and Russell; each was highly complimentary of the other.

[387] Severn, 'The Great Melbourne Telescope', *Argus*, 24 Feb. 1870, p. 7; 'Royal Society of Victoria', *Argus*, 14 Jun. 1870, p. 6.

[388] Russell, 'A Startling Astronomical Discovery', *The Observatory*, 1879, 178–80.

All of these affairs were reported in papers throughout Australia, helping to keep Proctor's name alive with the public as the highest profile popularizer of his day. Only John Tyndall, former President of the British Association for the Advancement of Science, and by 1880 into the latter stages of his career, rivalled Proctor as a public scientist of international repute for the colonial media. It is no coincidence that both men were particularly associated with controversy. Proctor's 1880 tour certainly lived up to these precedents—and more.

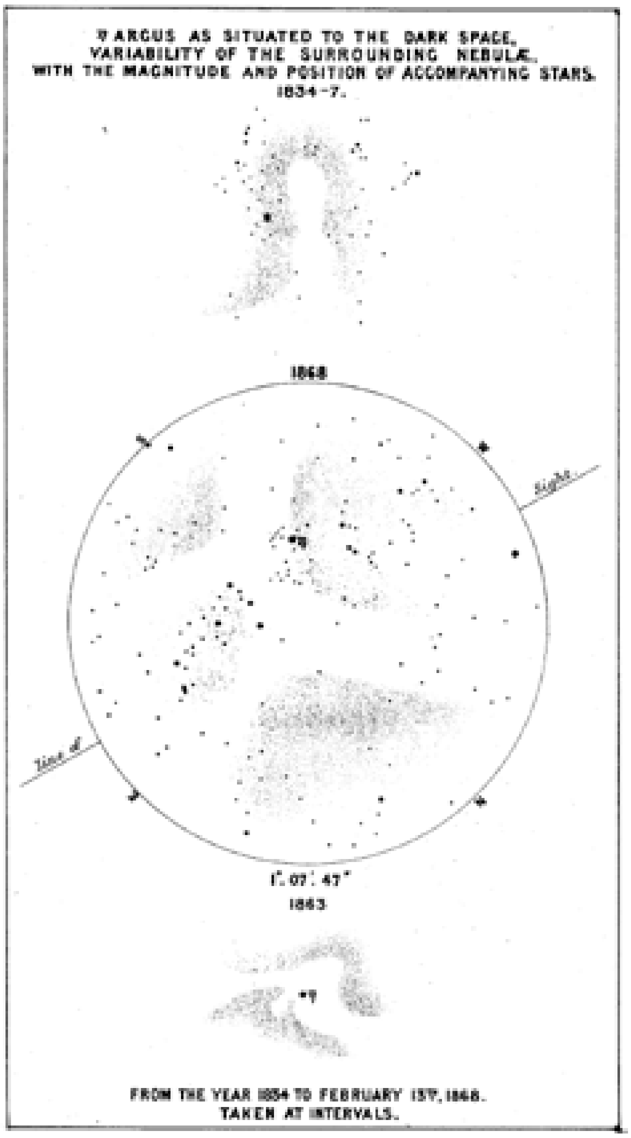


Figure 3.7 Francis Abbott's drawing of Eta Argus, 1868

This drawing of Eta Argus was prepared by Tasmanian amateur astronomer Francis Abbott to accompany his article to the *Monthly Notices of the Royal Astronomical Society* of May 1868. In this article he claimed that major changes had occurred in the appearance of the nebula since it had been observed by John Herschel in South Africa in the 1830s. This was a significant claim, since the physical nature of the nebulae was one of the biggest questions in nineteenth century astronomy, and Eta Argus one of the most interesting of the nebulae.

Features of the drawing, especially the non-standard terminology, were used to discredit Abbott. Proctor threw his full weight behind this campaign. This was a major incident in the rejection of amateur astronomers by the professionalizing astronomical community.

3.6: Proctor and controversy

3.6.1 Cometary apocalyptics

Having described some of the techniques involved in the specific performances of Proctor's popularization, I will return to a broader view of his tour, and specifically the role that controversy played in its success. A particularly vivid public discussion in Australia concerned Proctor's opinions about comets. As was discussed in § 2.5.1, comets were of great interest throughout the nineteenth century, especially so throughout the Australian colonies. Many of these discussions deplored the superstitions placed on the appearance of comets in earlier times yet were quick to catalogue new, scientifically established hazards that the celestial visitors might bring. Few contributed to this catalogue more forcefully than Proctor.

On 24 November 1876, Dr Julius Schmidt of the Athens Observatory detected a 'new star' in the constellation of Cygnus; the star flared up suddenly and then faded over the course of the next few weeks. This observation was itself newsworthy—variable stars and novae were a puzzle for astronomy at the time—and some attention was given to Schmidt's discovery in the Australian papers.[389] This was, however, completely eclipsed by the interest shown in Proctor's commentary on it.

In March 1877 an article by Proctor entitled "Suns in Flames" appeared in the London magazine *Belgravia*. This article begins with Proctor's assessment of the effects on Earth should the Sun experience a similar burst of activity:

[389] 'Astronomical Notices', *Australian Town and Country Journal*, 7 Apr. 1877, p. 18.

> If our sun were to increase as greatly in light and heat, the creatures on the side of the earth turned towards him at the time would be destroyed in an instant. Those on the dark or night hemisphere would not have to wait for their turn till the earth, by rotating, carried them into view of the destroying sun. In much briefer space the effect of his new fires would be felt all over the earth's surface. The heavens would be dissolved and the elements would melt with fervent heat.[390]

The final third of the article focuses on Proctor's speculation about a possible cause for such outburst—meteoritic impacts associated with the passage of a large comet.

> If a very large comet followed by no denser a flight of meteors, but each meteoric mass much larger, fell directly upon the sun, it would not be the outskirts but the nucleus of the meteoric train which would impinge upon him. They would number thousands of millions. The velocity of downfall of each mass would be more than 360 miles per second. And they would continue to pour in upon him for several days in succession, millions falling every hour. It seems not improbable that under this tremendous and long-continued meteoric hail, his whole surface would be caused to glow as intensely as that small part whose brilliancy was so surprising in the observation made by Carrington and Hodgson. In that case, our sun, seen from some remote star whence ordinarily he is invisible, would shine out as a new sun, for a few days, while all living things on our earth, and whatever other members of the solar system are the abode of life, would inevitably be destroyed.[391]

At this stage the physical nature of the Sun was not known for certain but it was commonly believed to have a solid surface, similar to the Earth's but surrounded by a glowing atmosphere. Meteoritic impacts were in fact a specialisation of Proctor's; he was one of the first to clearly articulate the impact theory for the origin of the Moon's craters,

[390] Proctor, 'Suns in Flames', *Belgravia*, Mar. 1877, 32–52.
[391] Ibid.

in contrast with the volcanic origin theory more commonly held (including by Nasmyth, the famed illustrator of the Moon's surface).

Proctor would go on to conclude the article[392] by deciding that such a catastrophe was "exceedingly unlikely". However the rhetorical impact had already been made. By foregrounding a catastrophe in the opening of the paper and then detailing it towards the end it was clear that readers would generally take the message: Proctor says that a meteor colliding with the Sun could extinguish life on Earth. And this message was indeed inferred by many. One prominent example was the *Scientific American* which picked up Proctor's theory and included it in its list of ten possible 'fates' for the "last man" on Earth in the issue of 26 May 1877.[393]

Both the *Scientific American* article and the *Belgravia* article itself were heavily reported in Australia. A telling indicator of the extent to which people were aware of this theory is that it could be used in jocular asides, such as when the *Queenslander* reported that

> two days of intense heat followed, during which the glass registered upwards of 90° in the shade, and everybody was disposed to believe that Mr Proctor's theory anent a momentary increase of solar heat, by that much-abused comet, might be coming true. On Monday, however, the wind shifted back again to the south, and now drizzling rain, slushy roads and general discomfort are once more the order of the day.

The *Belgravia* article laid out the basis of Proctor's theory but he did not let the matter rest there. Over the next decade he would push the theory along, repeating it at opportune moments. The most significant of these for this thesis was during his time in Australia. While on his tour he penned an article for the *Victorian Review* entitled "A

[392] It is notable that a significant portion of the middle portion of the article consists of an assessment of the reliability of various amateur astronomers' claims to have observed the new star in Cygnus; in this it is reminiscent of his role in the Eta Argus dispute described above.

[393] 'The Fate of the Last Man', *Scientific American*, 1877, 321.

Menacing Comet". This referred specifically to the comet observed in Australia earlier that year in February. Proctor used the calculations of Albert Marth to speculate that this comet was the same as that observed in 1843 but with a rapidly diminishing period, and thus destined to soon spiral into the Sun. His language in this article was more restrained than in his earlier *Belgravia* article, but only slightly. Although he thought there was only a "possibility, nay, even some degree of probability, that this comet may bring danger to the solar system" by the end of the article he was again assuring his readers that

> It is equally certain that if at any time a great comet falling directly upon the sun, should, by the swift rush of its meteoric components, excite the flame of the sun to a lustre far exceeding that with which he at present shines, tho sudden access of lustre and of heat would prove destructive to every living creature, or at any rate to all the higher forms of life upon this earth. And though in a few days the sun might resume his ordinary lustre, and no longer glow with abnormal heat, he would pour his rays on a family of worlds in which not one of the higher forms either of vegetable or animal life would remain in existence.[394]

This new article, appearing in a local publication was even more widely reported in Australian newspapers than the earlier one. Moreover, Proctor incorporated the new material into his lecture on comets and meteors, so the article and its reportage was valuable advertising for the lectures. A number of interested public members wrote letters to register their scepticism about these theories, but the widespread impact of them was clear.

Nor was interest in this theory allowed to die out after the tour. In 1882 Proctor again repeated his views on the possibility of comets impacting the Sun with a reprint of the *Victorian Review* article as an essay in *Familiar Science Studies*; again this attracted attention in newspapers around the world. By this stage, however, Proctor was backpedalling harder on the more apocalyptic aspect of his theory. In response to the

[394] Proctor, ‘Suns in Flames’, *Belgravia*, Mar. 1877, 32–52.

initial commentary on the essay he wrote a statement in *Knowledge* disavowing any implication of a likely catastrophe:

> I should esteem it a favour (though I think I might almost claim it as a right) if those newspapers who have spread the news of my supposed prediction, would be good enough to explain that I believe the world is more likely to last 15 millions of years than to be destroyed in 15. Fifteen millions of years will satisfy even the Positivist.[395]

In a letter to the *New York Times* later that year he also downplayed the possibility of any catastrophe: "through the approaching encounter between the sun and a comet... it will not be the sun which will suffer".[396] However Proctor could not overcome the strong association between his speculations and the idea of the world's end. Proctor's arguments in "A Menacing Comet" were the object of sober rebuttals not just from members of the public but this time by well-respected astronomers. Moreover the sight of an eminent celebrity publicly retracting an extreme claim was an easy target for newspapers. Proctor was the subject of another round of satirical articles across the globe, such as the steady stream from *Melbourne Punch* in 1882 and 1883.[397] Although Proctor would lecture and publish on comets again, he would not further develop the subject of a world-ending cometary collision with the Sun.

Proctor's handling of the public discussion of comets, their meteoric trains and their possible impacts with the Sun reveals a number of aspects of scientific popularization, both specifically in regards to Proctor as well as in relation to broader practice. While Proctor's theory was unquestionably based in one of his personal areas of expertise, he also clearly extended it beyond what his astronomical colleagues regarded as defensible. This was itself not unusual; it was entirely consistent with Proctor's understanding of the

[395] Proctor, '(No Title)', *Knowledge: A Monthly Record of Science*, 1882.

[396] Proctor, 'The Sun and the Comet', *Mercury*, 11 Jan. 1883, p. 3.

[397] 'The Comet', *Melbourne Punch*, 22 Jun. 1882, p. 8; 'The Recent Peculiar Sunsets', *Melbourne Punch*, 29 Nov. 1883, p. 9; Ibid.

independent, individual scientist. Yet his publication of "A Menacing Comet" while in Australia, his use of it as publicity for his lectures and his later republication of the essay show that he also had the public in mind, and for this audience he enrolled a well-developed cultural trope about comets, as harbingers of doom.

Proctor was able to use his public persona and the associated authority to be able to harness and transform a significant cultural understanding about comets. In this he was largely successful—his theories on this matter were widely known and understood, although not always believed. Questions of authority in relation to cultural schemata of astronomy would also be significant in relation to the second major controversy of Proctor's visit, although here we would be less successful in transforming the broader understandings.

3.6.2: Religion

Public interest in Proctor’s opinions about comets was considerable but by far the most controversial aspects of Proctor’s lectures in Australia were to do with their relationship to religion. Proctor was an advocate for the autonomy of professional science: from amateur involvement, from state support, and from religious interference. Proctor’s move away from Anglicanism and conversion to Catholicism had been prompted by his marriage to Mary Mills. After her death he publicly renounced this Catholicism and later described himself as an agnostic in the pages of *Knowledge*. Lightman has described Proctor’s religious views as a form of Spencerian universalism although he was also allied with the more dogmatically agnostic naturalists Huxley and Tyndall.[398] (Indeed significant differences did not emerge between these groups in Proctor’s lifetime.) Proctor’s religious views, too, were known in Australia. In April 1880, shortly before Proctor’s tour, the

398 Lightman, *Victorian Popularizers of Science*, 2009.

Australian Town and Country Journal reported on Proctor's religious views including his renunciation of Catholicism.[399]

Australia's religious communities were not entirely hostile to Proctor's tour. At the end of his tour it was noted that "clergy of all denominations from the Bishop of Melbourne downwards, recommended their congregations to go and hear the eminent lecturer". The Reverend James Jefferis[400], Congregationalist minister in Sydney and Proctor's later disputant, first mentioned Proctor in a sermon delivered in Adelaide at the opening of the Congregationalist Church at College Park.[401] Jefferis had heard Proctor speak about "The Moon—Our Companion Planet" at the Melbourne Athenaeum on the 8th June and his tone was generally positive.

Yet religious disquiet with Proctor's lectures grew throughout the tour. Correspondents to the newspapers felt that Proctor's visions—of solar systems destined to die and grow cold, of inhabited planets throughout the universe, and especially of the universal prevalence of physical laws—was "highly injurious to divine revelation and the Christian faith".[402] Proctor occasionally replied to such correspondents, but remarking that his lectures were "not intended either for the uneducated or the feeble-minded"[403] was hardly likely to conciliate. Nor was saying that

> only folly little short of idiocy can cause any decently educated person to regard the vastness of the universe, its immense duration in time, and the

[399] 'Evolution and Religion', *Australian Town and Country Journal*, 24 Apr. 1880, p. 27.

[400] Phillips, 'Jefferis, James (1833–1917)'.

[401] 'Opening of the Congregational Church, College Park', *South Australian Register*, 14 Jun. 1880, p. 6.

[402] A Distant Observer, 'Mr. Proctor's Lectures', *South Australian Advertiser*, 21 Jul. 1880, p. 10.

[403] Proctor, 'Astronomy and Religion', *South Australian Chronicle and Weekly Mail*, 7 Aug. 1880, p. 4.

> perfection of the laws which have fashioned its various parts, as reasons for abandoning belief in an omnipresent ever existing Being[404]

The theological questions came to a head in Sydney. Back in front of his own congregation, James Jefferis selected the subject of “The Highest Teachings of Astronomy” as the subject for his sermon on Sunday 29th August. This was brought to Proctor’s attention, and he introduced his lecture on Saturday 28th August with a brief discussion of the relationship between science and religion as he saw it. Proctor reprised his views: that science and true religion must be compatible; that God’s nature and thoughts were unknowable; and that the incomprehensible vastness of time and space revealed by astronomy stood as a lesson for this. But although Proctor stressed the general consistency of science and theology, he nonetheless addressed some pointed comments towards religions in particular. Proctor:

> thought scientific teachings were chiefly valuable … because they indicated the universal prevalence of law, and consequently the futility of lawlessness, no matter under what high or even sacred names disguised.[405]

Proctor also used this occasion to announce that he would deliver his final lecture, on "The Birth and Growth of the Universe", on a Sunday: the 5th September.

Jefferis delivered his sermon, and for good measure followed it up with a letter to the *Sydney Morning Herald* the following week. This time there was no holding back. According to Jefferis, Proctor was:

> not very careful in his dealings with theology. … Does Mr Proctor think that theologians are insane, or is it that he himself has never read this sacred drama, and contented himself with quoting a quotation?[406]

[404] Ibid.

[405] ‘Mr. Proctor’s Astronomical Lectures’, *Sydney Morning Herald*, 30 Aug. 1880, p. 6.

Proctor replied archly with a letter that not only showed that he was familiar with the texts in question but which pointed out his own theological training. A second, more conciliatory letter from Jefferis appeared, apologizing for relying on the reports in the press—he had not actually been present at Proctor's lecture—and attempting to reconcile the differences between the astronomer and himself.[407]

3.6.3: Henry Parkes

The theological argument stood there, but that was only the prelude to the full drama in Sydney. Proctor's announcement of a Sunday lecture—at the theatre where freethinkers lectured on that day—offended Christians of a Sabbatarian inclination, many of whom would go on to re-form the Lord's Day Observance Society in the wake of his tour. People like Presbyterian minister John McGibbon lobbied the Premier of New South Wales, Sir Henry Parkes, in person and through the press in letters to the editor.[408]

Parkes decided to act. On Thursday 2nd September Parkes instructed Inspector-General of police Edmund Fosbery to prevent the lecture from taking place in the terms advertised. Fosbery called on Smythe and told him that the lecture was illegal and not to be delivered. Smythe immediately wrote to Parkes detailing reasons to believe that the lecture was legal. Amongst other things he pointed out that no money would be taken at the door for Proctor's lecture, and that exactly the same arrangement had prevailed in London for many years without complaint. This was, in fact, not entirely true. Sunday lecturing was still somewhat controversial in London in 1880; there had been successful prosecutions against them little more than a decade earlier, and the law that was relied upon for these prosecutions was not repealed until 1896.[409] Proctor was promoting in New South Wales a

[406] Jefferis, 'Astronomy and Theology', *Sydney Morning Herald*, 2 Sep. 1880, p. 6.

[407] Jefferis, 'Astronomy and Theology', *Sydney Morning Herald*, 4 Sep. 1880, p. 3.

[408] '(No Title)', *Sydney Morning Herald*, 13 Sep. 1880, p. 4.

[409] Barton, 'Sunday Lecture Societies', 2014.

campaign he had supported in England, rather than transferring a well-established practice.

In any case, Parkes stood firm. On the Friday he reiterated his stance and again Smythe replied: in deference to Parkes' decision no further Sunday lectures would be given but it was impossible to return the tickets already sold and since they were convinced it was lawful the lecture would be given. On the Saturday evening the Inspector-General of Police, Fosbery, visited the owner of the theatre, Samuel Lazar and informed him that Parkes would revoke his theatrical licence if the lecture were given. Lazar had a long meeting with Proctor and Smythe on the Sunday and they confirmed their intention to proceed. Fosbery returned once more, repeated his threat and a little more than two hours before the start of the lecture Lazar wrote a pleading note to Proctor asking him to call off.[410]

Details of what happened next are readily available from the newspaper reports.[411] Crowds started milling from 7 o'clock and soon a crowd of more than 2000 assembled in front of the Theatre Royal. Specially laid on ferries had brought some of them across the harbour and specially laid on trains had brought others in from the suburbs. The commercial arm of the government at least was supporting the lecture. Around 7:45 pm, when word had spread that the lecture was not going to be given, Proctor appeared on the balcony of the Oxford Hotel next door and addressed the crowd:

> I shall ask you, as soon as you possibly can, to disperse. In this matter I have acted, not from any consideration of my own interests, but because I was assured by the lessee of the Theatre Royal that his license would have been revoked by the Colonial Secretary—(groans)—who has the power to do so.

---

[410] 'Stoppage of Mr Proctor's Sunday Lecture', *Sydney Morning Herald*, 6 Sep. 1880, p. 6.

[411] Unfortunately a file on the incident from the Colonial Secretary's Office, including the report by Police Commisioner Fosbery, appears to be missing from the State Archives in NSW. This missing file was noted as long ago as 1970. See Phillips (1970), 'The Churches and the Sunday Question in Sydney in the 1880s' *Journal of Religious History* 6(1) 41–61 fn. 64

> (Cries of "Shame.") I need hardly tell you that, so far as my own risk was concerned, I was prepared to have run that risk. (Cheers.) I am a law-abiding citizen, and I obeyed the law. With the loss of the Theatre Royal it was a question of ruin; with me it was a question of a few hundred pounds. In this matter I have only yielded at the last moment to what is, practically, police interference. (A Voice: "Try again next Sunday.") I appeal to you, as good and loyal citizens, to retire to your several homes as quickly as possible. One thing we may do before we retire, and that is to give three cheers for law and order, and three cheers for the Queen.[412]

One of the biggest public controversies of the era erupted. Sabbatarians were delighted. Prominent Protestant clergy lined up to congratulate Parkes. At least one cleric—the Unitarian Rev McDonnell—wrote to Proctor, inviting him to come lecture on a Sunday[413] but there is no other public record of such support. The Catholic *Freeman's Journal*—never very fond of the Sabbatarian movement but very fond of haranguing Parkes—was critical of the decision, although it would seem to have been more through a desire to attack the Colonial Secretary than to defend Proctor.[414] According to the *Jewish Herald*:

> Judaism alone stood quietly by, and said nothing, because it had no cause to fear any danger from the revelations of science.[415]

Proctor did manage to offend Australian Jews by the end of the year: an article written while in New Zealand and appearing in the *Victorian Review* of December 1880 suggested astronomical connections for Jewish rituals and in particular between sacrifices and sun-worship; the *Jewish Herald* suggested that his opinions in this matter should be taken "*cum grano salis*".[416]

---

412 'Stoppage of Mr Proctor's Sunday Lecture', *Sydney Morning Herald*, 6 Sep. 1880, p. 6.

413 Proctor, 'Letter from Richard A. Proctor to Reverend McDonnell, 11 September 1880', 1880.

414 'Parkes and Proctor', *Freeman's Journal*, 11 Sep. 1880, p. 13.

415 'The Synagogues', *Jewish Herald*, 3 Dec. 1880, p. 4.

416 'Astronomy and the Jewish Festival', *Jewish Herald*, 17 Dec. 1880, pp. 6–7.

There were a number of local factors that operated as background to the Proctor–Parkes incident. For the Colonial Secretary himself, Sir Henry Parkes, the immediate backdrop to this was the looming election. Having spent the last decade swapping in and out of the Premiership, Henry Parkes was near the zenith of his political career. He had eclipsed his personal rival and former Liberal associate John Robertson on the eve of the 1879 election and had spent a whole term in the ascendency. The biggest issue of that term had been the Education Act, the latest in the regulation of schools and one that would finally cut off public money to denominational schools. Many Protestants acquiesced unwillingly to the passage of the Bill. Senior Catholics were outraged but Parkes, who had courted (or at least not avoided) anti-Catholic sentiment through much of his career[417] would not have been concerned with that. Pandering to Sabbatarian inclinations was an olive branch to—mainly Protestant—religious interests.[418]

In any case, before the Parliament ended Parkes sought an extension of powers for the Colonial Secretary to prohibit performances. For once in this term Parkes did not get his way and the bill was withdrawn.[419] As the subsequent Proctor dispute unfolded Parkes, not having the power he had sought at his disposal, reached for another power to use, his control of theatrical licences. His Attorney-General, Robert Wisdom, provided a written opinion that such an action would be unlawful but Parkes ignored that.[420] Parkes' actions in this affair embodied his persona as a coalition-making, dealing politician who had grown accustomed to exercising his authority personally and arbitrarily.

The incident represented broader political trends as well. The Sabbatarian movement itself was on the rise in the Australian colonies, having been dormant through the late 60s and 70s; it would continue to generate pressure throughout the 1880s until, like a number of social movements, interest in it fell away again in the face of the 1890s depression. The

[417] Martin, 'Henry Parkes and the Political Manipulation of Sectarianism', *Journal of Religious History*, 1976, 85–92.

[418] 'Sidney Bigotry', *Echo*, 2 Oct. 1880, p. 2.

[419] 'Legislative Assembly', *Evening News*, 23 Jun. 1880, p. 3.

[420] Buchanan, 'Mr Proctor's Sunday Lecture', *Sydney Morning Herald*, 14 Sep. 1880, p. 6.

government of New South Wales had never itself made concessions to Sabbatarianism: public operations like the museum, art gallery and railways always operated on Sundays. Indeed the government insisted that not only its own employees must work but that licensed ticket sellers remain open on the Lord's Day.[421] In other colonies Sabbatarians had been more successful—museums and railways had been closed on Sundays at various times in South Australia and Victoria.[422] Indeed it was in Victoria that Sabbatarians had had one of their biggest successes before Proctor. Earlier in 1880 another famous British popularizer had had a Sunday lecture on astronomy shut down by the police. This was John Henry—the 'Professor'—Pepper. This incident provides the most striking point of similarity between Proctor and Pepper's tour.

[421] Phillips, 'The Churches and the Sunday Question in Sydney in the 1880s', *Journal of Religious History*, 1970, 41–61.

[422] 'The Public Library', *Argus*, 7 Jul. 1883, p. 11; 'Opening Northern Railways on Sundays', *South Australian Register*, 2 May 1881, p. 6.

3.7: Professor Pepper in Australia

Like Proctor, Professor Pepper was a prominent British popularizer on a tour of the colonies. Indeed Pepper had been in the public eye for considerably longer, having been the face of the London Polytechnic since 1848 as its lecturer, and even more so as its manager from 1854 and author of the *Boy's Playbook of Science* in 1866.[423] A breakdown in relations with the directors led to him finally leaving the Polytechnic in 1872. After running his own establishment for a few years he went on to conduct lecture tours in North America and then, from 1879 in Australia.

Although it started well, Pepper's tour of Australia was ultimately much less successful than Proctor's would be a year later. Pepper's arrival was highly anticipated; indeed a committee of prominent citizens formed to provide him a suitable welcome in Melbourne.[424] Initially lecturing to full houses at the St George's Hall, by the end of a six week run through July and August, with performances almost every night, audience numbers had started to drop away. It was in the more competitive entertainment environment of Sydney that the problem with audience numbers really started; it is also where some changes in his routine appeared, including a greater emphasis on his 'Ghost' routines; Figure 3.8 shows that the *Illustrated Australian News* portrayed this as the most notable part of his performances. After finishing in Sydney in early December Pepper then toured though country New South Wales, Tasmania and country Victoria before returning to Melbourne for a second season in April 1880. This second season was not nearly as successful as his first. Barely two weeks after starting his audiences were

[423] Pepper, *The Boy's Playbook of Science*, 1866.

[424] 'Professor Pepper', *Argus*, 1 Jul. 1879, pp. 5–6.

described as “poor”.[425] Pepper’s ability to draw repeat audiences was low, despite the greater variety of material he deployed, in marked contrast to Proctor who, throughout his tour, was able to persuade considerable numbers to sit through his entire programme. By June Pepper was offering his services to the education department—having lectured for schools throughout his career—and reduced the number of public performances he gave. In August—just weeks after Proctor had appeared there—Pepper took his operation to Adelaide. He briefly reprised the early success of his tour, receiving some of the warmest receptions of his tour. But the financial stress of the tour was clearly taking its toll: Pepper summarily dismissed one of his assistants who then successfully took Pepper to court for non-fulfilment of contract.[426] In the aftermath of this incident Pepper sold his equipment and moved to Brisbane where he took a position as Government analyst, while retaining his sideline of schools lecturing.[427]

Pepper’s operation differed from Proctor’s in a number of respects. Where Proctor lectured as an expert with global standing in a single field—astronomy—Pepper presented much more as a generalist. His personal expertise was in chemistry, but his performances, billed as ‘Science Festivals’, covered other subjects including optics, acoustics, electricity and magnetism, astronomy, and spiritualism. Nor did Pepper confine himself to strictly scientific subjects: the centrepiece of his performances were demonstrations of the ‘Peppers Ghost’ illusion developed at the Polytechnic, while as an ardent debunker of spiritualism he frequently demonstrated sleight-of-hand tricks and how they could be used by charlatans. The lantern views interspersed throughout his performance included current affairs like overseas conflicts and torpedo warfare (quite a popular subject of the time, torpedoes having been newly invented), and the ever-popular subject of travel destinations in Europe and America. This variety act, despite having a scientific focus,

[425] ‘Melbourne Theatricals’, *Launceston Examiner*, 19 Apr. 1880, p. 3.

[426] ‘News of the Week’, *South Australian Chronicle and Weekly Mail*, 15 Jan. 1881, p. 7; ‘Police Court - Port Adelaide’, *South Australian Advertiser*, 7 Jan. 1881, p. 3.

[427] Cane, ‘John H. Pepper: Analyst and Rainmaker: The Genesis of Chemistry Teaching in Queensland’, *Journal of the Royal Historical Society of Queensland*, 1975, 116–33.

was not entirely to his advantage. One sympathetic audience member from Hobart, William Morris, wrote to his brother:

> I attended Pepper's lecture on the Spectrum Analysis and Polarized Light. It was a capital lecture with beautiful illustrations (experiments) with the lime light and electric light and his so called "Ghost" was very curious. The lectures were to some extent a mixture half devoted to science and the remainder of the evening to a theatrical farce. The lectures (except when it was that it was on pure science) were not well attended.[428]

Pepper was caught between his role as a showman and his role as an expert. Moreover this variety was logistically demanding and thus expensive. It required an enormous amount of equipment, trained staff and, on occasion, actors. The lantern itself was used to perform optical demonstrations in persistence of motion, and with specific apparatus like the 'astrometroscope' while other physical demonstrations included pendulums, tuning forks, combustions and so on. Pepper is reported to have had "five waggons of apparatus" that weighed "twenty tons".[429] Only for a small number of people was this an attraction. William Morris wrote in his next letter

> It is a pity more interest was not shown as it will be many years before a lecturer of his stamp with such a quantity of apparatus will pay us a visit.[430]

By contrast Proctor travelled with just himself, Smythe, and a single assistant. The considerable burden of Pepper's larger operation no doubt had a significant impact on the financial viability of the tour.

[428] Morris, 'Letters, William Knibb Morris to Thomas John Morris, July 1877-1880', 1880.

[429] 'Latest Intelligence', *Bendigo Advertiser*, 12 Jul. 1880, p. 2.

[430] Morris, 'Letters, William Knibb Morris to Thomas John Morris, July 1877-1880', 1880.

Source: Trove

Figure 3.8 ‘Professor Pepper and his ghosts’, 1880

The *Illustrated Australian News* of August 2 1879 featured an article on Professor Pepper’s performances at the St George’s Hall, shortly after his arrival in Melbourne. Although Pepper was met warmly and had initially good crowds, numbers quickly declined and he eventually abandoned his tour in 1880.

This illustration shows the importance of the ‘Ghost’ to both Pepper’s fame and his performances. More broadly it shows him in the guise of a scientific showman rather than specialist lecturer. The triunial lantern pictured in the foreground reinforces the centrality of visual techniques to Pepper’s—and Proctor’s—lecturing.

3.7.1: Pepper and Astronomy

One of the more significant changes to Pepper's repertoire to emerge from his declining audience numbers in Sydney is the inclusion of astronomy into his programme. Around this time he acquired, or started using, a set of commercially produced astronomy slides (although he augments this set with slides of spectrographs taken from his own collection). Astronomy is worked into his general 'science festivals' but also form the basis of single lectures with a dedicated theme. Notably on two Sundays 30 November and 7 December 1879 Pepper presented two 'secular sermons' at the Victoria Theatre. Moreover these were presented on exactly the same basis as Proctor would propose: tickets pre-sold, with advertised prices.

There was no campaign against—or even much notice of—Pepper's Sunday lecturing in Sydney. Pepper had had no background of conflict with religious authorities and his theology was more orthodox. Nor did he appear at a venue known as being a home of freethought. However when Pepper started giving Sunday lectures on astronomy on his return to Melbourne they were noticed.[431] On Sunday 23 May 1880 in preparation for his sixth Sunday lecture the police paid Pepper a visit: he was acting illegally by taking money at the door on Sundays and would be prosecuted if he did so. The arrangements were quickly changed; tickets were not sold and instead a collection was taken.[432] Pepper gave at least two more Sunday lectures on this basis but soon abandoned the practice. This 'success' in the operation of Sunday trading laws in Victoria was referred to as a precedent by the Sabbatarian lobbyists in Sydney later that year (although they never referred to Pepper's earlier Sunday lectures in Sydney!) In contrast with the later incident with Proctor, the interference with Pepper's lecturing received scant attention in the press, both in Victoria itself and interstate.

[431] Figaro, 'In the Barber's Shop', *Telegraph, St Kilda, Prahran and South Yarra Guardian*, 17 Apr. 1880, p. 3.

[432] 'Victoria', *Evening News*, 27 Apr. 1880, p. 2.

3.7.2: Comparing Memories of Pepper with Proctor

The difference in reception between Pepper's and Proctor's Sunday lecturing was not the only difference in their public reception. Proctor was remembered in Australia well and long. In the years immediately after his tour he remained prominent within the Australian press. Although his regular column in the *Australasian* terminated with his tour, his publications continued to be reviewed, and occasional columns, both original and reprints, were published. In particular, his ideas about cometary impacts with the Sun were widely reported, as described in § 3.6.1. Proctor's sudden death, supposedly from yellow fever, in New York in 1888 was reported throughout the country.

Within both religious and freethought communities Proctor was particularly remembered. In 1884 a Sabbatarian deputy to then Premier Alexander Stuart would urge him to emulate Parkes and close all theatres to secular lecturers on Sundays.[433] In 1887, after Parkes had returned to the Premiership and done just that, it was liberals, freethinkers and trades-unionists who formed a delegation to the Premier asking him to reverse his decision; again the Proctor case was a cultural touchstone.[434] By 1890, after Proctor's death, freethought lecturers like William Whitehouse Collins would explicitly claim Proctor as one "of their advocates".[435] The *Protestant Standard* disputed this description,[436] although the year before they had been happy, at least, to claim him as an anti-Catholic.[437]

So too would Proctor's use of visualization be remembered. More than a decade after Proctor's tour a school principal would write to the Tasmanian Treasurer to apply for the vacant position of meteorological and astronomical observer. For Andrew Ireland, the visual technology of "large wall maps and diagrams and oxyhydrogen lantern views"[438]

[433] 'New South Wales', *Argus*, 24 Jul. 1884, p. 7.

[434] 'The Closing of the Theatres on Sundays', *Sydney Morning Herald*, 14 Jun. 1887, p. 4.

[435] 'Sydney Freethought Hall', *Sydney Morning Herald*, 27 Jan. 1890, p. 3.

[436] 'Much Ado About Nothing', *Protestant Standard*, 8 Feb. 1890, p. 3.

[437] 'Galileo, Professor Proctor, and the Papacy', *Protestant Standard*, 23 Mar. 1889, p. 9.

[438] Ireland, 'Letter to Bolton Stafford Bird', 1892.

were central to the practice of astronomical lecturing and he invoked Proctor's memory to make his case.

> You may remember that the great astronomer the late Professor Proctor adopted the above method of illustrating his subjects. These diagrams and views to which others could be added from time to time, give a general view of the heavens, the solar system, the principal nebulae, comets, views of separate members of the solar system, and the various phenomena they present, etc.[439]

In 1922, over forty years after Proctor’s tour, he was “still remembered in Australia as a fascinating lecturer”.[440]

One event in this period that helped to sustain memories of Proctor was the tour of Proctor’s daughter Mary in 1913. After Proctor’s death, both his daughter and his widow Sallie became astronomical lecturers. Sallie fulfilled Proctor’s existing lecture engagements, and later repeated a series of these lectures, while Mary became a popular lecturer in her own right after having been asked to speak at the Chicago World Fair.[441] In 1912 Robert Ball was asked to undertake a speaking tour of Australia to promote the idea of a solar observatory to the Australian public and politicians in the lead-up to the meeting of the British Association for the Advancement of Science to be held in Sydney in 1914. (The proposal would eventually be realized as the Mt Stromlo Observatory.) Ball, then 73 and in failing health demurred and suggested that Mary Proctor go instead. From 1912 and 1913 Mary undertook speaking and social engagements in every colony. Although acclaimed in her own right as a lecturer, many accounts of Mary in this time made explicit reference to her father’s tour in 1880.[442]

---

439 Ibid.

440 ‘Proctor’s Paradoxes’, *Recorder*, 7 Jun. 1922, p. 4.

441 ‘News and Notes’, *Dawn*, 5 Oct. 1889, p. 13; ‘Obituary’, *Australian Town and Country Journal*, 6 Jan. 1904, p. 55; ‘An Interesting Career’, *New York Times*, 9 Sep. 1894, p. 18.

442 ‘A Lady Astronomer’, *Advertiser*, 24 Sep. 1912, p. 9; ‘Miss Mary Proctor’, *Sydney Stock and Station Journal*, 12 Jul. 1912, p. 2; ‘Statement by Miss Proctor’, *Daily News*, 31 Jul. 1913, p. 3.

A good indication of how strongly Proctor persisted within Australian cultural memory is the extent to which he was satirized. A joke is useless if the reference is not well-known. One example is Henry Parkes himself: one good way of measuring his commanding presence in late nineteenth century politics in New South Wales is that barely a week went past without him being lampooned in the *Bulletin*. (See Figure 3.9.)

In this regard Proctor clearly achieved the status of cultural icon for late nineteenth century Australians. From about 1885 until well into the 1890s the famous vaudeville artist Horace Bent performed a "Burlesque lecture" "'Astronomy a la Proctor' by Professor Horace Bent L.X.Y.Z., A.S.S.".[443] This lecture was evidently a well-known and popular part of Bent's repertoire; The *Windsor and Richmond Gazette* also noted that "His description of the moon, &c., caused much laughter, and he had to respond to an almost deafening encore with a few of his earlier recitations"[444] while three years earlier the *Sydney Morning Herald* had observed that this popular lecture was "illustrated with comic charts, and during the discourse the house was kept in continued laughter".[445] Bent's 'astronomy a la Proctor' would itself be remembered in print as late as 1925.[446] Other satirical efforts, such as those by the *Melbourne Punch* were referred to earlier; Figure 3.10 shows one such effort from 30 December 1880. Clearly Proctor was a rich source of humour within the Australian tradition. Compared with this, Pepper's legacy in satire was thin. Apart from a brief burst of articles in 1882 lampooning Pepper's rain-making attempts, *Melbourne Punch*, for example, paid him very little attention.

Newspaper reports over the following decades remember Proctor's visit far more frequently than they do Pepper's. It seems that 'the Professor' was much less well remembered than Proctor in Australian cultural memories. This is despite a considerable set of circumstances: involvement in disputes about Sunday lecturing, a second career living and working in Australia for a decade, responsibility for such noteworthy feats as

[443] 'Richmond Minstrel Club', *Windsor and Richmond Gazette*, Jun. 1896, p. 6.

[444] Ibid.

[445] 'Gaiety Theatre', *Sydney Morning Herald*, 20 Mar. 1893, p. 9.

[446] 'Musical Memories', *Daily Mail*, 4 Oct. 1925, p. 10.

rain-making experiments and introducing the phonograph to Australia. To some extent this difference might be explained by the way those histories were written, and thus the different class composition of the audiences for the two popularizers—Proctor certainly commanded the attention of colonial society's elite, such as the South Australian Governor[447]—but the difference in audience composition was probably only slight. Apart from Pepper more consistently advertising children's prices, the cost of tickets for each was about the same. Instead the format of the show, and the kind of context that it came to be viewed in was probably a significant factor in how each was remembered. Proctor already had a literary reputation and his tour came to be seen as a significant part of the colonies' intellectual life, not least because of the extended controversies over the relationship between science and religion as espoused by him. Proctor managed to become part of a cultural conversation, one that moved across a series of lectures and through various publications. Proctor became an authority for—at least an aspect of—science within the culture. This was not the case for Pepper. Partly because of his prior reputation and the history colonial audiences had with him, partly because of the variety style of his performances, Pepper became a performance, something to be seen once. He was viewed in a much more theatrical context and yet was placed in a far more peripheral relationship to the memories and histories created for this context. The scientific lecture or performance has never been central to histories of the stage.

[447] 'Scientific', *South Australian Chronicle*, 24 Jul. 1880, p. 15.

AN ASTRONOMICAL STUDY.

FIRST YOUTH: "My word! there's a lot of stars, ain't there? No one could count them!"

SECOND YOUTH: "Yes, God can."

THIRD YOUTH (*an authority*): "He's not the only one. I bet Parkes could!"

Source: State Library of Victoria

Figure 3.9 'An Astronomical Study', 1891

The extent to which a historical figure is satirised is a good measure of their cultural impact. Henry Parkes' commanding presence in late nineteenth century politics in New South Wales is attested to by the fact that barely a week went past without him being lampooned in the *Bulletin.*

This cartoon was published in the *Bulletin* on 11 April 1891. It is impossible to know whether there was any extra humour intended from the characterisation of Parkes as an astronomical authority eleven years after the Proctor–Parkes dispute, although other reports show that the incident was still remembered at this time.

Source: Trove

Figure 3.10 'Astronomical Notes', 1880

This satirical cartoon of Richard Proctor appeared in *Melbourne Punch* on 30 December 1880 as part of the *Punch Almanac for 1881*.

This was just after Proctor had left Australia, and memories of him were still fresh. However jokes about him would continue, and burlesque satirisations of him be performed for decades to come. By this measure Richard Proctor reached the level of a cultural icon in late nineteenth century Australia.

3.8: Conclusion

The tours of Proctor and Pepper in Australia were extremely high-profile professional popularizations of science in general, let alone of astronomy in particular. Both popularizers lectured to many thousands of people in multiple colonies and attracted media attention across the country, in a way that had never before happened for popular scientists.

In part this reflected the emergence of science communication as a profession. Thomas Huxley and Richard Proctor in Britain, and Camille Flammarion in France were amongst the first who could earn most or all of their income from popularization. They would soon be followed by others, such as Robert Ball, Agnes Clerke, Mary Acworth Orr and Richard Proctor’s daughter Mary Proctor.

However Richard Proctor and Professor Pepper were not equally successful. Proctor was clearly the far more well-received. While many factors lay behind this, it is clear that their cultural performances were a large part of this. Proctor projected as an expert and successfully engaged the major cultural schemata of astronomy: astronomy telling of a sky that is a source of power and danger; astronomy giving us insight into religion; astronomy as an exemplary science; and astronomy that speaks to the human condition through the possibilities of life elsewhere. In particular, Proctor’s mobilisation of the astronomical sublime, a cultural schemata in its own right was outstanding. Pepper, on the other hand, was received as a celebrity. He mobilised many of the same schemata but in a manner that was less skilful, with didactic aims that were far more particular. His theatricality and demonstrations was ultimately too unwieldy to be managed and his variety style was less able to compete with its entertainment industry rivals. As a consequence he proved to be a smaller target for cultural conservatives and this itself resulted in less notoriety.

The circumstances of these tours were not identical and unquestionably these idiosyncratic factors were substantial aspects of the difference in their receptions. The theatrical context of popular astronomy was significant here, as it was in Britain.[448] Proctor's management was exemplary while Pepper's material practice had very material costs. Other factors confounding the directness of comparison between Proctor and Pepper include that, while both were high-profile celebrities, Proctor was, in 1880 near the height of his international reputation while Pepper was clearly in the later part of his and had already experienced diminishing audiences. As discussed, these pre-existing trajectories were reinforced in Australia.

Nonetheless, it seems clear that both Richard Proctor and Professor Pepper came to Australia with the potential to fashion a successful tour. The many differences in their reception and memorability can in significant part be described through their differential manipulation of cultural schemata.

[448] Huang, 'Commercial and Sublime', PhD thesis, 2015, pp. 290–91.

4: Visual and material practices in popular astronomy

Richard Proctor was one of the most successful astronomical popularizer to appear in colonial Australia. He deployed all of the major cultural schemata associated with astronomy: the astronomical sublime and the relationship with religion, astronomy as an exemplary science and the history of astronomy as a history of thought, and the plurality of worlds debate. He also operated with a sophisticated media environment, including visual technologies and a commanding presence in print. His success was in large part due to all of these.

The schemata of popular astronomy were bound up with the technologies through which they were delivered. The intent of a cultural history of popular astronomy, focussing on schemata, is not to separate ideas once more from histories of the local and material, or to reify ideas as the sole locus of historical change, but rather to trace out the different rates at which these transformations occur. Media technologies played a crucial role in this.

This chapter will focus on these media technologies of popular astronomy: visual, mechanical devices and print. It details how these technologies of display and performance were associated with the schemata of popular astronomy.

In all of these technologies the role of visual communication was strong, even relative to the well-known interest in visuality of the Victorian era. I thus start with an overview of visual communication in astronomy based largely on the secondary literature, before moving to its specific applications in the media of lanterns, astronomical devices and print drawing on new evidence on how these technologies were applied in Australia.

4.1 Astronomy and visual communication

The persistent association of astronomical lectures with illustration has already been demonstrated in this thesis, from early lantern lectures in the colony through Mechanics' Institute lectures to Richard Proctor and Professor Pepper. A range of visual aids could be used to illustrate a lecture, including large charts, blackboard drawings, paintings or illuminated transparencies. This diversity of formats is not always well appreciated today. However, by far the most common device was the magic lantern. As will be shown later in this chapter, visual communication in astronomy extended to other formats as well, including mechanical devices such as orreries and illustrated books. The meanings of this persistent association between astronomy and visuality will be discussed in this section.

Over recent decades, scholarship in the humanities has gone through a 'visual turn'. This has been seen in multiple disciplines. One of the most central to this has been the discipline known as Visual Studies. A useful overview of the development of this discipline is given by Dikovitskaya.[449] In general, Visual Studies has tended to focus on painting and photography, and especially artistic images, perhaps reflecting its emergence from the academic discipline of Art History. Non-art images in general and scientific images in particular have received much less scholarly attention. Elkins is one of the few scholars working within this tradition who has devoted significant attention to non-art images.[450] His tripartite arrangement of the domain of image into word, image and notation is of particular interest to the iconography of popular astronomy, since much illustrative material had a strongly diagrammatic character, or in Elkin's terms, had a strong presence of notation.

[449] Dikovistskaya, *Visual Culture*, 2005.

[450] Elkins, *The Domain of Images*, 1999.

Historians, too, have paid increasing attention to visual forms as a different kind of evidence, as described in Peter Burke's *Eyewitnessing*.[451] Importantly for this thesis, Victorian history, and histories of science have had a particular interest in the visual. The extensive scholarship on these include: analyses of the role of seeing in scientific practice;[452] the connections between images, image making and scientific epistemology;[453] the significance of visual forms in popular publishing[454] or entertainment;[455] sociological analyses of the role of visuality in the constitution of Victorian society;[456] and broader cultural histories of seeing.[457] The first two of these are concerned primarily with processes internal to practicing scientific communities. Although the overlap between this domain and that of popular culture has been described and considered in this thesis, nonetheless, these are of less relevance here. The latter three, however, are all significant.

Throughout the nineteenth century an extremely wide range of subjects were displayed using the lantern, both in Australia and elsewhere. Early catalogues of slides list subjects such as: dioramic and panoramic scenes of popular tourist destinations; portraits of famous people; animated comic images; astronomy; and other sciences such as geology, natural history and botany. With the exception of portraits, all of these would remain staples throughout the century, although fashions would shift. In the mid-nineteenth century, special effects, such as chromotrope slides appear. Catalogues towards the end of the century feature temperance, and other morality stories, as well as the above subjects, and American catalogues of the late nineteenth century are particularly rich with Bible illustrations. Depictions of recent events were also prominent: American catalogues

[451] Burke, *Eyewitnessing : The Uses of Images as Historical Evidence*, 2001.

[452] Anderson, 'Looking at the Sky', *The British Journal for the History of Science*, 2003, 301–32; Rothermel, 'Images of the Sun', *The British Journal for the History of Science*, 1993, 137–69.

[453] Daston and Galison, *Objectivity*, 2007.

[454] Lightman, 'The Visual Theology of Victorian Popularizers of Science', *Isis*, 2000, 651–80.

[455] Morus, 'Seeing and Believing Science', *Isis*, 2006, 101–10.

[456] Otter, *The Victorian Eye*, 2008.

[457] Crary, *Techniques of the Observer*, 1992.

feature many Civil War sets, while late scenes from the Sudan War would be common in England and the colonies.

Although only a small part of the overall range of lantern slides available, those slides featuring sciences were of considerable interest for lanternists operating in schoolrooms, churches and Mechanics' Institutes, venues that were the bulwarks of lantern practice in Australia. Amongst the sciences, astronomy was one of the most common subjects, if not the most common, to be presented with the lantern.

There are several reasons for the particular association of astronomy with lantern lectures. Some aspects of astronomy made it an attractive subject for lecturing in general within the institutions in which lantern practice was strong such as the cultural schemata of astronomy as giving insight into religion or as an exemplary science, as in §2.6. For astronomers in the mould of Proctor, visual communication was an important resource. According to Nall:

> The divide between a public astronomy centred on the natural history of the heavens and a professional astronomy centred on precision measurement appeared to be reconfiguring itself … Above all, it would be changes in the scope and impact of communications technologies that would prove crucial.[458]

More broadly within scientific practice, the importance of visual techniques has been emphasized by Schaffer.[459]

Within lanternist practice, astronomy had a certain prominence; astronomical slides were a high point of mechanical sophistication.[460] Typical astronomical slides included many kinds of animated effects. Indeed astronomical sets included complex slides involving multiple and concealed gearwork mechanisms to reproduce motions such as the

[458] Nall, 'News from Mars', PhD thesis, 2013, p. 79.

[459] Schaffer, 'Transport Phenomena', *Early Popular Visual Culture*, 2012, 71–91.

[460] Butterworth, 'Astronomical Lantern Slides', *The Magic Lantern Gazette*, 2007, 3–11.

differential motion of the planets in an orrery slide, the elliptical motion of a comet, and the orientation of the earth's axis as it orbits the sun. The pricing reflected this; astronomical slides were generally amongst the most expensive that could be purchased. E. M Clarke's Catalogue, for example, lists a set of astronomical images for £5.10, compared with £3.13 for the next most expensive set (of panoramic scenery).[461]

The significance of these sets for lanternist practice will be discussed further in § 4.2.2, but, along with other forms of visual aids, they show a strong early association of astronomy with visual communication within this practice. This association was readily exploited by popularizers, who generally shared a belief in the educative potential of visual techniques. Lightman and Morus,[462] amongst others, have described how these visual techniques were used in other contexts. They were certainly taken up quickly by lecturers in the Australian colonies and just as well appreciated by audiences. For many people, to show an image *was* to explain.

> The third transparency illustrating this system was the chef d' ouvre of the evening, and did infinite credit to Mr. Giblin and those who must have assisted him in producing it, explaining as it did at a glance and in the clearest manner the motions of the heavenly bodies.[463]

There is a recurring conviction in the efficacy of visual communication. For example:

> The lecturer was assisted by Dr. Huxtable in illustrating various parts of his subject, with fine reflections, thrown upon a disc, of various astronomical pictures, thus teaching through the eye as well as the ear.[464]

461 Clarke, *List of Prices*, 1842, pp. 34–36.

462 Lightman, 'The Visual Theology of Victorian Popularizers of Science', *Isis*, 2000, 651–80; Morus, 'Seeing and Believing Science', *Isis*, 2006, 101–10.

463 'Mechanics' Institution', *Hobart Town Courier*, 28 Nov. 1829, p. 4.

464 'Mechanics' Institute Lectures on Astronomy', *Courier*, 30 Sep. 1854, pp. 2–3.

> The illustrations of the lecturer were rendered so simple as to be understood by a child of seven.[465]

> The language of which pictures are the written words is one which is understood by all nations. Ideas communicated by such characters are comprehensible by the world's population.[466]

However this conviction was not uniformly shared; at least some people recognised the limitations of visual forms. Some viewers, like those present at St Mary's Seminary in Sydney in 1853, might think that "The Astronomical slides were, certainly magnificent, and most instructive, but they needed explanation".[467] Others did not just see visual communication as limited, they rejected it almost entirely, regarding it as an inferior form of learning.

> Surely it is not necessary, in the present day, to resort to diagrams in order to prove the sphericity of the globe… We are afraid, however, that the too copious use of such ocular demonstrations is attended with but little good—they indeed gratify the eyesight—but, in the case of persons entirely ignorant of such matters, fail to inform the understanding.[468]

The belief in the potential of visual communication was widely shared and guided people's interpretation of events like lantern lecture, but these beliefs were not uniformly shared. This diversity of opinion speaks to the need to understand cultural schemata as collective, but not totalizing intellectual structures.

465 'Astronomical Lecture', *Balmain Observer and Western Suburbs Advertiser*, 5 May 1888, p. 5.

466 'The Cosmopoligraphicon', *Age*, 3 May 1855, p. 7.

467 'Dissolving Views', *Freemans' Journal*, 24 Sep. 1853, p. 10.

468 'Mechanics' Institute. The Rev C Price's Lecture', *Cornwall Chronicle*, 10 May 1845, p. 2.

But the association of astronomy with visualization goes beyond these widely shared views about visual communication, which, after all, do not explain why astronomy was more commonly presented in a visual form than many other sciences. To some extent this reflects the visual nature of the scientific practice, yet astronomy was certainly not the only science of the period with such practices. Techniques of seeing associated with meteorology were also important to that science;[469] the main concern of geology at that time, stratigraphy, had an emphasis on 'reading the landscape' and microscopy was another characteristically visual practice. The difference between astronomy and other sciences with respect to the visual was in the relationship between lay audience, observation and expertise. The social organization of astronomical expertise, the popular associations of astronomical theory, even the prominence of the night sky in daily life have all changed substantially over the last few centuries. The accessibility of the night sky to popular observation, however, has always been strong. Meteorology—the other science of the sky, often associated with astronomy—comes close to this relationship as, to a somewhat lesser extent, natural history. Other sciences are far more removed from popular observation. Stratigraphical observation, for example, depends far more heavily on prior skills, while microscopy cannot be practiced without instrumentation. Astronomy, like relatively few other sciences, allows a visual experience within everyday life that could provide at least a partial access to the scientific realm.

It was not just the practice of astronomy that was visual, but also its communication. Astronomical theory placed a great emphasis on geometry and this aspect of the science—the orbital arrangement of the planets known as 'the system of the world'—lent itself to pictorial expression. Figure 4.1 is a series of charts produced by the Working Men's Educational Union in the 1850s for use in lectures. Such charts were common educational aids; Proctor travelled with a set of charts for use when he could not obtain a lantern.

The value of this emphasis on geometry for astronomical popularizers went beyond mere convenience. The association with geometry reinforced the schema of astronomy as an

[469] Anderson, 'Looking at the Sky', *The British Journal for the History of Science*, 2003, 301–32.

exemplary science of exact knowledge. Well into the nineteenth century geometry, even above all other forms of mathematics, stood as the model for ideal human knowledge in British thought, especially in the form of Euclidean geometry.[470]

Astronomy thus had a persistent association with visual communication for many reasons internal to the practices of the science, of popular institutions, of lanternists or of publishers. However it was also due to the cultural schemata of astronomy. How these schemata were expressed through the various visual technologies of lantern slides, of mechanical devices and of print will be described in this chapter.

[470] Richards, *Mathematical Visions*, 1988, p. 2.

Source: National Maritime Museum, Greenwich, London
ZBA4550 (l), ZBA4551 (top r), ZBA4553 (bottom r)

Figure 4.1 Wall hangings, Working Men's Educational Union, 1850s

These astronomical wall charts were produced by the Working Men's Educational Union in the 1850s for use in lectures. Proctor travelled with a similar set of such charts, which he used when he was not able to procure a lantern. Although the lantern slide itself is still undervalued as an important nineteenth century medium, the diversity of other forms of visual aids, including charts, transparencies, paintings and drawings, is even less appreciated.

Such aids reflected a belief in the educative potential of visual techniques.

4.2 Magic lanterns

4.2.1 Overview of lanterns in Australia

The magic lantern[471] was one of the most widespread popular entertainments of its day, yet it scarcely exists in today's historical memory. And its significance within the history of media goes even beyond that unquestioned popularity: "The magic lantern was the first medium to contest the printed word as a primary mode of information and instruction".[472] Lantern practice gave us the word "slide" for one image in a sequence. The 35mm slide projector is probably the technology most comparable for audiences who grew up in the twentieth century, while the PowerPoint 'slide' is the most ubiquitous contemporary successor. The presence of the lantern is still with us although memory of it is the province of relatively few specialists. As such, this section will give an overview of lantern ppractice based largely on the secondary literature.

Lanterns were projectors that used glass slides of varying sizes, but in the later part of the nineteenth century typically around 6cm across for a single image. They were somewhat more versatile than the typical usage of the twentieth century's 35mm slide projector. Biunial or triunial lanterns (Figure 4.2)—with two or three lenses respectively—allowed cross-fading from one slide image to another, showing, for example, the portrayal of a sequence of day to night, or summer to winter (Figure 4.3). This technique gave rise to the term "Dissolving Views", one of the most common ways in which lantern shows were advertised. Individual slides also came with animated effects with one sheet of glass being

[471] Laternists have long disliked the adjective 'magic' as the performance is entirely technological, yet the word 'magic' stuck. I will therefore use 'lantern' to describe the technology, but will refer to the 'magic lantern' when describing the social artefact.

[472] Gunning, 'Introduction', 2000, p. xxvii.

slid or rotated across the surface of a fixed sheet, giving rise to moving images such as a turning water wheel, or the comic effect of a rat being swallowed by a snoring sleeper. As will be seen, astronomical slides particularly took advantage of the range of animated effects.

The lantern existed throughout the nineteenth century in a succession of technological stages. At the beginning of the nineteenth century oil or paraffin lamps were used as lantern illuminants. The limited light produced by these was adequate for small scale projection, but the flowering of the lantern as a public entertainment required the development of a brighter illuminant: limelight. This was produced by directing a hot flame—usually oxy–acetylene—against a block of lime. Another technological innovation involved in public performance was the development of techniques to allow rear-projection, by using a screen of tissue-paper, or damp muslin. The carbon arc lamp, powered by electricity, was also developed in the mid-nineteenth century and by the end of the century electric illumination would become the dominant form used for lanterns.[473]

The reproduction of lantern slides also saw a series of developments. The glass slides were initially hand-painted. As more sophisticated methods of mechanical imaging were developed, these were successively applied to slide-making. At first copperplate techniques were used, wherein black outlines would be transferred onto the glass to be hand coloured, before lithographic reproduction and then photographic techniques were employed. These techniques of production were increasingly embedded in industrial systems of distribution and trade by commercial firms. In particular, while photographic techniques allowed the production of individualised images by lanternists—a subject that will be discussed later—they also furthered the mass-production of prepared sets by commercial firms. By the last decades of the nineteenth century a truly industrial supply chain for lantern practice had been established. The production of prepared sets of slides, for all kinds of image production, and the effects of these practices will be described in § 4.2.2.

[473] Crompton and others, *Servants of Light*, 1997.

Despite its widespread popularity in the nineteenth century in Australia, the magic lantern has only recently started receiving scholarly attention. Elizabeth Hartrick's thesis, 'Consuming Illusions'[474] remains the definitive study to date.[475] Hartrick's thesis, concerned to recover and map the cultural practice of lanterns in Australia and New Zealand particularly focuses on the way the production and circulation of images reinforced the identity and connections of Australia within a global system:

> The magic lantern not only maintained white colonial audiences' vital connection to what might be termed a British Imperial world vision, it also brought the colonised into an understanding of their position as subjects within the colonial/imperial universe.[476]

Internationally the lantern has fared a little better, with historians of early cinema like Gunning and Rossell providing accounts of the intertwined practices of lanternists and cinematographers.[477] Much of this work, however, is recent, and despite it there is an ongoing tendency to collapse the lantern in all its forms with the other technologies of 'pre-cinema', thus largely obscuring it in history. As Hartrick notes

> This historiographic oversight is consistent with an approach already identified in the international literature which conceptualises earlier visual technologies within the teleological narrative of the achievement of twentieth century cinema, and which posits a pre-cinema history in which primitive proto-forms, such as the magic lantern and its repertoire of visual effects, were developed and discarded.[478]

---

[474] Hartrick, 'Consuming Illusions', PhD thesis, 2003.

[475] Hartrick's book was published in March 2017 after the submission of this thesis and now serves as the most authoritative account of the magic lantern in Australia and New Zealand.

[476] Hartrick, 'Consuming Illusions', PhD thesis, 2003, p. 246.

[477] Gunning, '"Primitive" Cinema: A Frame-up? Or the Trick's on Us', *Cinema Journal*, 1989, 3–12; Rossell, *Living Pictures: The Origins of the Movies*, 1998.

[478] Hartrick, 'Consuming Illusions', PhD thesis, 2003, p. 29.

It is worth observing that the same is largely true with regards to much of the early 'actuality cinema', the pre-1910 period of filmmaking that revolved around presenting scenes of everyday life, before the narrative revolution in film-making most commonly associated with DW Griffith.

A second, related mistake is to undervalue the extent to which cinema practitioners and audiences alike drew upon the well-established visual literacy created by lantern cultures.[479] One example is given by the micro-cinematographical work of Francis Martin Duncan for the Charles Urban production *Unseen World* (1903), which clearly recapitulated the lantern-based oxy-hydrogen microscope presentations of an earlier generation in a new format (Figure 4.4). The relationship between lanternist practices and those of early cinema are complex and a story of direct continuity is little more satisfying than the more common historical lacuna:

> Studies such as Mannoni's and Rossell's immediately discredit the metaphor of biological paternity and the family romance of discovering the true father (or mother) for cinema- that poor shivering foundling abandoned on the doorstep of art and commerce sometime at the end of the nineteenth century… the device we recognise as motion pictures, when traced backwards, fragments and multiplies, unveiling a skein of influences and practices that move back into centuries-thick layers of culture and history.[480]

The need to appreciate the diversity of forms of visual technology used in popular astronomy was also discussed in the previous §4.1.

A third common historiographical oversight with respect to the lantern is a failure to appreciate its long historical tail. Not only did it co-exist with cinema as a public format for longer than is generally recognised, it survived in contexts where the authority of the lecturer remained significant such as universities, churches and community groups.

479 Kember, *Marketing Modernity*, 2015, p. 2.

480 Gunning, 'Introduction', 2000, pp. xi–xii.

Specialist collections of scientific slides for teaching continued to be used within universities well into the twentieth century.

It is, however, the case that the public prominence of the lantern was in decline by 1890. There are a range of reasons for this. By this time familiarity with the magic lantern was widespread. Lanterns were by this time a common domestic item for middle class families. Universal schooling and the use of the lantern in education would also have both increased children's familiarity with the lantern and moved its association away from an entertainment, both undercutting a commercial market. Despite increased familiarity, many aspects of the format had stabilised over the previous decade, creating a mismatch between expectations and experience. The basis of authority within society had also changed by 1890, away from the 'local expert' and towards the national or international expert. By the end of the nineteenth century the dominant contexts where the lantern remained strong were those where such local expertise was still valued: school building funds, church benefits, temperance leagues, as well as university and school teaching. Such institutions were also well placed to take advantage of the cheaper and more readily available catalogue sets of photographic lantern slides.

The role of the lantern in purely public entertainments declined throughout the 1890s and 1900s. There was a small resurgence of interest in lantern presentations in the 1930s.[481] That at least some of this revival was explicitly based around adults referring to the technology of their childhood is suggestive of the development of nostalgia from the adults who had been the last generation to have been exposed to lantern entertainments as children.

As with other aspects of colonial culture, practices of the lantern and related visual entertainments were initially transferred from Britain but immediately took on new associations in Australia, and subsequently developed differently. Significant differences influencing this divergence include the geography of and within Australia, and the

[481] 'Picture-Minded. Magic Lantern Come-Back', *Methodist*, 18 Apr. 1936, p. 4.

smaller institutional and industrial bases. In the Australian colonies, especially early in this period, large-scale and elite institutions like the Royal Society, Adelaide Gallery or the Polytechnic were thin, or entirely absent. The smaller, more widely spread population made things harder for the travelling lanternist. Early attempts at commercial lanternists were generally unsuccessful. In Britain, only the "great lanternists" survived into the latter part of the nineteenth century, the "travelling lanternist's hand-to-mouth trade became obsolete around the middle of the nineteenth century, killed off by the mass production of lantern equipment".[482] However in Australia the itinerant lanternist only really took off in the 1870s and beyond.[483] The core of lanternist practice in Australia in the mid-nineteenth century was the layer of churches, schools and Mechanics' Institutions.

Nonetheless, communicative technologies were of particular significance to the culture of colonial Australia, dispersed widely from not just the remembered home but from other colonies.[484] Hartrick has argued that the lantern was a particularly powerful force in shaping colonial identity and relationship, both in presenting images of 'home' to native-born Australians, and in creating and displaying images of Australia in Britain.[485]

The same can be said for the construction of understandings of science in colonial Australia. While derived from British traditions, colonial Australian attitudes to science developed in their own ways, as suggested in § 2.1, through a self-image as a new society not bound by the social and economic structures of Britain, and with an enhanced interest in communicative and other practical technologies. The way that sciences contributed to colonial understandings of place-making, was one aspect of this, and as this thesis has demonstrated, astronomy was a significant contributor to that process.

---

[482] Mannoni, trans. by Crangle, *The Great Art of Light and Shadow*, 2000, p. 276.

[483] Hartrick, 'Consuming Illusions', PhD thesis, 2003, pp. 72–73.

[484] Blainey, *Black Kettle and Full Moon*, 2004, p. 88.

[485] Hartrick, 'Consuming Illusions', PhD thesis, 2003.

Source: Museum Victoria ST 38022

Figure 4.2 Triunial magic lantern, 1891

This is a triunial—or three-lens—projector. Two- and three-lens projectors allowed one image to be crossfaded with another, a technique known as 'dissolving views'. Not all lanterns were as complex as this one.

This lantern was manufactured by London firm Otway & Sons in 1891.

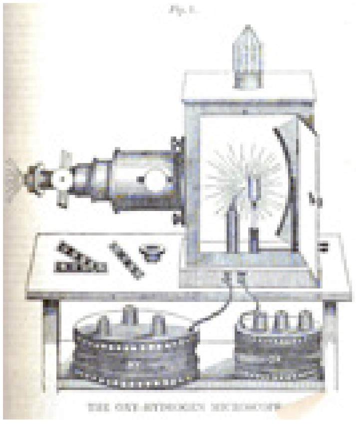
Source: Museum Victoria MM 31922 and MM 31923
Used under Creative Commons Attribution 4.0 International

Figure 4.3 Dissolving view slides

These images show a pair of ‘dissolving view’ slides. When used in a projector with multiple lenses, a skilled lanternist could crossfade one image to the next. In this instance it would give the appearance of a gradual transition from summer to winter.

This kind of visual effect was something that lantern slides were well known for. These effects helped to create a visual culture in the nineteenth century.

Source: Science and Society Picture Library
Used with permission



Source: Internet Archive

Figure 4.4 Francis Martin Duncan, 1905 and Oxy-hydrogen microscope, 1841

The larger image shows Francis Martin Duncan pictured with his photomicrographical equipment, which was used to create the 'Unseen World' series of films with Charles Urban in 1903. These films, which were screened in Australia, featured a range of microscopic imagery, one of the most notable of which was a film about cheese mites.

These techniques drew on the tradition of projection microscopes used by a previous generation, as shown in the illustration from the front cover of the *Magazine of Science*, Saturday 2 January 1841.

The development of the established genre of lantern microscopy into microscopic film shows a clear example of continuity of practice from the lantern era to early cinema.

4.2.2: Visual, material and social practices of magic lanterns

The visual communication of popular astronomy described in the previous section shows how visual practices were inextricably embedded within material culture and practices. Lantern shows depended on a range of technological and commercial practices and on the tacit skills of lanternists, and were presented in defined social contexts. Nasmyth's remarkable book was based on a craft tradition of modelling, required newly-developed printing techniques and was circulated through a global trade. As such both are powerful examples of Mitchell's injunction that "There are no visual media";[486] all media are mixed in form.

Inevitably the social and material practices within which visual communication was embedded influenced its significance. For lantern shows, the complex production and context of performance were particularly important. The presence of the lecturer in the performance of the lantern show has been referred to in the previous § 4.2.1. This established a particular relationship between vision and word. It may have been the case that "An ounce of picture is worth a ton of words",[487] but stripped of words entirely the lantern slide—and lantern lecturer—were diminished in value. In Elkins' terms, lantern slides almost always had strong elements of notation.

The centrality of the lecturer to the performance meant that construction of their authority was highly significant. This touches on social understandings of knowledge and expertise. Over the course of the lantern era, various bases of authority were relied upon. At first, when lanterns were scarce, the mere fact of owning one created authority. Then authority moved to the local expert within the community, such as schoolteachers, clergy or gentleman. As society grew and urbanised, science professionalised and media

[486] Mitchell, 'There Are No Visual Media', *Journal of Visual Culture*, 2005, 257–66.

[487] Woolston, 'A Lanternist's Creed', *The Optical Magic Lantern Journal and Photographic Enlarger*, Jan. 1900, 2.

practices spread, attention shifted away from the local expert to the global celebrity, such as Richard Proctor. This can clearly be seen in evidence from the Australian context

From the 1870s, the 'local scientific gentleman' would be increasingly less of an authority; as W. J. Barkas would explain in a lecture of his own:

> Astronomy, Geology, Chemistry, and such like profound subjects have all been explained popularly by those men who have gained a world-wide reputation from their researches and discoveries into their respective sciences.[488]

In 1902, when lantern lecturing was strong but in decline, the *Bendigo Advertiser* would also note this shift in authority:

> The old professional lecturer, ready at a moment's notice to talk upon any topic suggested, is no longer in demand. Nowadays this "terrestrial ball" is being so thoroughly explored by land and sea in every direction that the question now put by the agencies to the man who wants to lecture is, Have you done anything? Or, Have you been anywhere? If so, we want you to talk about that.[489]

This question of authority has been important to the field of Visual Studies. One theme that runs through this work is the different forms of authority that the visual engage, and the changes that such forms take over time. Anderson, for example, describes how meteorological practice variously incorporated folk traditions through incorporating techniques of visual observation, and then professionalised through the development of visual instrumentation.[490]

[488] Barkas, 'Popular Lectures On a Human Tooth, Its Growth Structure and Uses', *Australian Town and Country Journal*, 26 Aug. 1876, p. 18.

[489] 'Mr Frank T. Bullen', *Bendigo Advertiser*, 28 Mar. 1906, p. 6.

[490] Anderson, 'Looking at the Sky', *The British Journal for the History of Science*, 2003, 301–32.

In the public performance of popularizers the cultural basis of authority constructed by the visual has also been emphasized by many scholars, including Morus.

> These and other forms of scientific showmanship were occasions for Victorians to celebrate the superiority of their industrial culture. Not only could they really do what past charlatans had only claimed to do, but they could see through the trick as well. Panoramas, phantasmagorias, and optical toys were certainly meant to evoke wonder in their spectators, but much of that wonder was meant to be directed at the technology that sustained the integrity of the illusion.[491]

The wonder "directed at the technology" has already been described with Proctor's imagery and Pepper's ghosts. More generally it was a significant aspect of lantern practice in the nineteenth century. Arguably, the greatest disruption between lantern culture and cinema culture was not the quality of the image. Both photographic images and animation were both well entrenched (albeit separately) in lantern practice, and early cinema technology was often criticized for poor image quality relative to good lanterns.[492] Instead, one of the major shifts to film culture involved the more direct relationship between audience and image (although the existence of the film lecturer in early cinema practice, as with much else of the crossover between lanterns and cinema, remains a persistently under-appreciated phenomenon[493]).

In his article, Morus also draws attention to the cultural value such performances held for their audiences (while also noting the fact that we know little in detail about these audiences). This social role of the visual is explored further by Otter, who describes two aspects to the understanding of visuality: the disciplinary and the spectacular (and goes on to complicate this commonly understood duality).

[491] Morus, 'Seeing and Believing Science', *Isis*, 2006, 101–10.

[492] 'Amusements', *Register*, 4 Nov. 1901, p. 6.

[493] Gunning, 'The Scene of Speaking', *IRIS-PARIS-*, 1999, 67–80.

> In the former, illumination is the means through which society is permeated by a nefarious, anonymous disciplinary gaze: light is a glittering tap. In the latter, illumination is seductive and dazzling, creating the stage on which the commodity makes its breathtaking appearance.[494]

The ways in which the authority for lantern lectures was socially constructed is therefore worth further examination. One of the practices that was central to facilitating the 'professional lecturer, ready at a moment's notice to talk upon any topic suggested' was the commercial availability of slide sets, complete with readings. Purchase of such a set allowed those with little background to be able to present a tolerably complete performance. That astronomical lectures based around the commercial set facilitated a discernible package can be seen through a number of examples. One is that astronomy lectures were scheduled at short notice as a stand-in when another lecturer had to cancel for some reason.[495] Another is that a man styling himself as Professor Muggeridge made an attempt to secure some free accommodation by taking a tour through rural South Australia, staying at hotels on account but leaving before paying, and it was the delivery of a series of astronomical lectures that was his front.[496]

The standard astronomical lantern sets started appearing early in the nineteenth century and their composition developed over the first half of the nineteenth century. Although of great interest to collectors, the precise develipment of these sets does not appear to have clearly been given in the literature. Nor are there good publications of complete sets, as in Table 4.1 of this thesis. The first sets appear to have been produced by the London instrument maker W & S Jones, who between 1817 and 1822 started advertising "a new set of moveable painted sliders, shewing the fundamental principals of astronomy, with the real and apparent motions and positions of the planets, stars, &c".[497] Shortly after this,

[494] Otter, *The Victorian Eye*, 2008, p. 2.

[495] 'Advertising', *Colonial Times*, 8 Aug. 1843, p. 1.

[496] 'The Kapunda Herald', *Kapunda Herald and Northern Intelligencer*, 21 Aug. 1868, p. 2.

[497] Jones, *A Catalogue of Optical, Mathematical, and Philosophical Instruments*, 1822; Jones, *A Catalogue of Optical, Mathematical, and Philosophical Instruments*, 1817.

around the mid 1820s, Phillip Carpenter—whose later firm Carpenter & Westley would become one of the most successful and influential slide manufacturer—produced his first set, the *Compendium of Astronomy*.[498] This was a set of eleven sliders with a total of 30 images (later expanded to twelve sliders with 38 images). In the 1840s, Carpenter & Westley developed a set of first nine then ten astronomical slides, each of them animated by rackwork mechanism.[499] This set was soon copied by many other firms such as W & N Newton, and Dollond. By the 1850s numerous sets were available, including an improved set by Jones, *A Key to the Study of Astronomy* by Francis West, and *A Popular Lecture on Astronomy*. Evidence from newspaper advertisements shows that this last set was one of the most popular in Australia. Table 4.1 shows the slides that it contains.

Such sets were invaluable to the non-expert, and especially the itinerant commercial lecturer; they would also shape the lectures of those who did have the required knowledge. That many astronomical lecturers used such sets is clear from a comparison of the slide sets and their associated readings with the descriptions of the lectures themselves. The 38 images above, in order, are listed as the syllabus of the lecture delivered by Hugh Wylie at Flemington Primary School in Melbourne in 1879. (Figure 4.5) Other lecturers who were clearly using commercial sets—and following the suggested lecture for them—include Charles Price, John Jennings Smith, James Martin and Frederic Race Godfrey.[500] As noted in the previous chapter even the eminent and experienced lecturer Professor Pepper was not above using such sets.

The consistency of these lectures was reinforced by the fact many of the commercial sets were very similar in content to each other to the extent that individual slide images were

[498] Butterworth, 'Astronomical Lantern Slides', *The Magic Lantern Gazette*, 2007, 3–11.

[499] Carpenter, *Popular Cyclopaedia of Natural Science. Mechanical Philosophy, Horology and Astronomy*, 1843, p. 578.

[500] 'Mechanics' Institute', *Launceston Examiner*, 21 Sep. 1844, p. 4; 'Tea Party and Lecture', *Maitland Mercury and Hunter River General Advertiser*, 15 Apr. 1846, p. 2; 'Lecture at the Institute', *South Australian Advertiser*, 28 Dec. 1861, p. 3; 'Popular Astronomy', *Argus*, 19 Jun. 1884, p. 6.

even sometimes copied from one manufacturer to the rest.[501] The commercial practices of slide production extended the reach of popular astronomy, but also helped to crystallise some of its largely standard features.

The material practices of commercial lantern slide sets had other effects on the practice of popular astronomy. The stability of the physical form also tended to stabilise the knowledge practices. Social aspects of this have been described above, but there were other, more anomalous aspects to this. Some lantern slide images showed discoveries claimed by astronomers but later rescinded as incorrect. The slides in Table 4.1, for example, show the planet Neptune with a ring, as claimed by Lassell in 1846.[502] Another example seen in lantern slides is the four moons of Uranus claimed by William Herschel in the 1790s but later retracted.[503] These slide images themselves might last for decades after they were produced, even after the scientific knowledge had changed. These mistakes highlight the contingent aspects of knowledge claims, made by particular people at particular points in time, while at the same time stabilising those claims and downplaying their origins. This is, in itself, a common feature of scientific knowledge claims, but they are emphasized by the physical format of the slide.

The form of the lantern slide also carried a particular historical and philosophical consciousness. Their role in emphasising the cultural schema of astronomy as an exemplary, geometrical science has been referred to throughout this section. The standard lantern slide set also looked back to the 'Tychonic System', and demonstrated that the world was round through an argument of hypothesis contrary to fact.

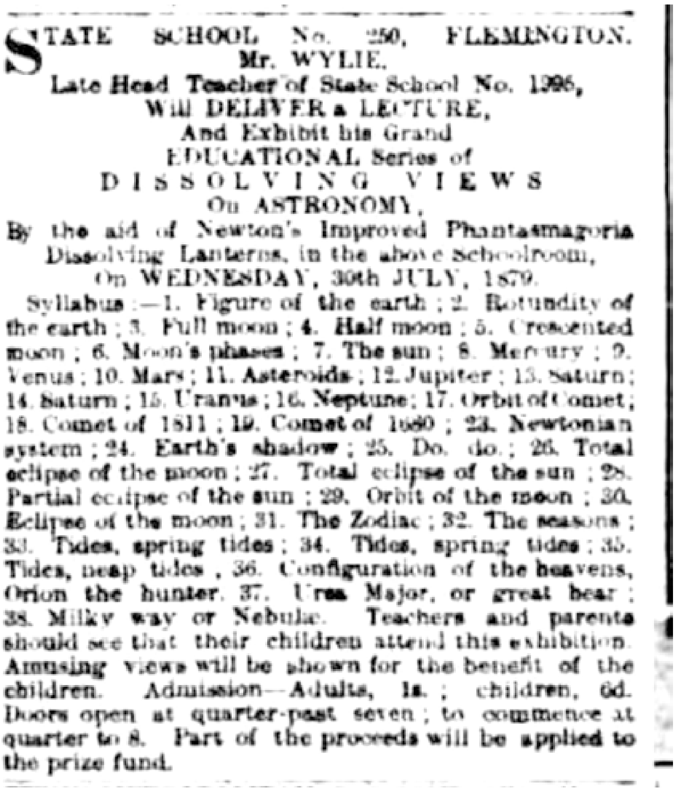
While these aspects reinforced the cultural schemata of astronomy, the 'locked in' nature of these earlier lantern slide images also made the artefact vulnerable to change. Eventually the format would collapse under its own weight.

---

[501] Butterworth, 'Astronomical Lantern Slides' (email), pers. comm., 15 Jul. 2011.

[502] Smith and Baum, 'William Lassell and the Ring of Neptune: A Case Study in Instrumental Failure', *Journal for the History of Astronomy*, 1984, 1–17.

[503] Kragh, 'Conclusion, and a Note on the Satellites of Uranus', 2008, pp. 145–54.



STATE SCHOOL No. 250, FLEMINGTON.
Mr. WYLIE,
Late Head Teacher of State School No. 1396,
Will DELIVER a LECTURE,
And Exhibit his Grand
EDUCATIONAL Series of
DISSOLVING VIEWS
On ASTRONOMY,
By the aid of Newton's Improved Phantasmagoria
Dissolving Lanterns, in the above Schoolroom,
On WEDNESDAY, 30th JULY, 1879.

Syllabus :—1. Figure of the earth ; 2. Rotundity of the earth ; 3. Full moon ; 4. Half moon ; 5. Crescented moon ; 6. Moon's phases ; 7. The sun ; 8. Mercury ; 9. Venus ; 10. Mars ; 11. Asteroids ; 12. Jupiter ; 13. Saturn ; 14. Saturn ; 15. Uranus ; 16. Neptune ; 17. Orbit of Comet ; 18. Comet of 1811 ; 19. Comet of 1680 ; 23. Newtonian system ; 24. Earth's shadow ; 25. Do. do. ; 26. Total eclipse of the moon ; 27. Total eclipse of the sun ; 28. Partial eclipse of the sun ; 29. Orbit of the moon ; 30. Eclipse of the moon ; 31. The Zodiac ; 32. The seasons ; 33. Tides, spring tides ; 34. Tides, spring tides ; 35. Tides, neap tides , 36. Configuration of the heavens, Orion the hunter. 37. Ursa Major, or great bear ; 38. Milky way or Nebulae. Teachers and parents should see that their children attend this exhibition. Amusing views will be shown for the benefit of the children. Admission—Adults, 1s. ; children, 6d. Doors open at quarter-past seven ; to commence at quarter to 8. Part of the proceeds will be applied to the prize fund.

Source: Trove

Figure 4.5 Advertisement for Wylie's lecture, 1879

This advertisement appeared in the *Age* on 29 July 1879. It features an advertisement for an astronomical lecture at Flemington State School in Melbourne, by Hugh Wylie, a retired head teacher.

The syllabus advertised for this lecture shows that Wylie was using the 'Popular Lecture on Astronomy' set of lantern slides. This set was one of the most commonly used in Australia at the time. Table 4.1 shows the slides that formed this set.

Table 4.1 'Popular Lecture on Astronomy' Slide Set

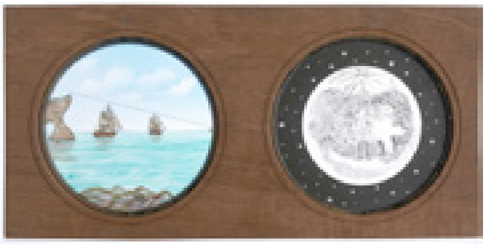
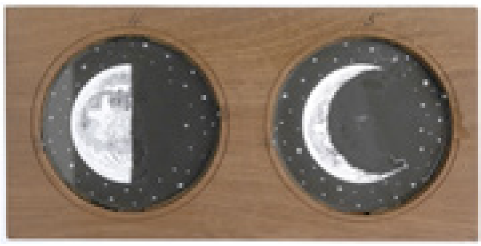
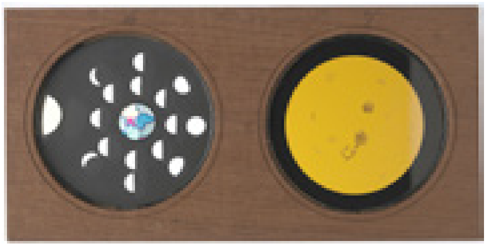
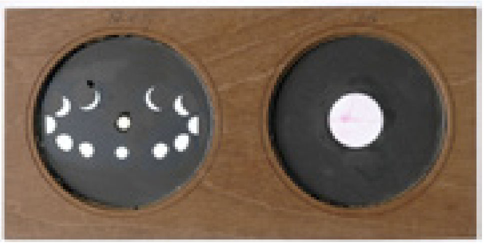
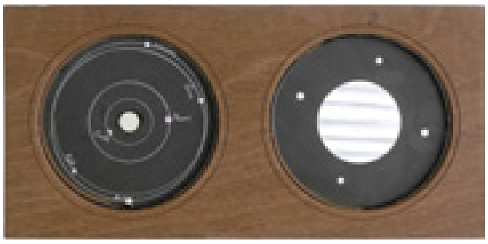
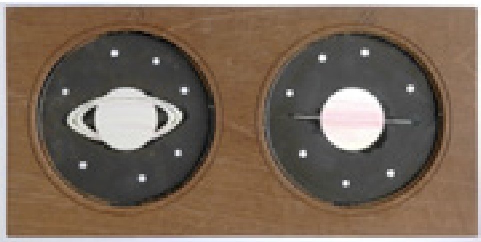
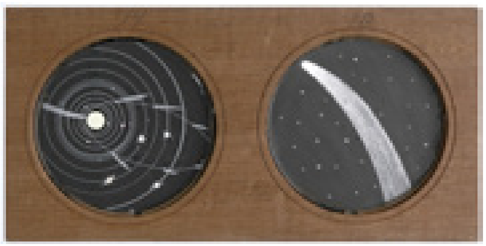
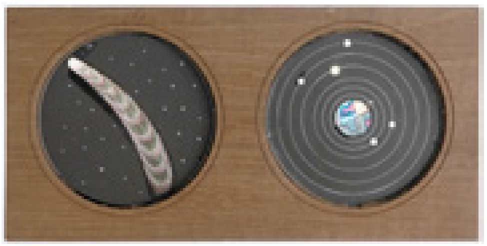
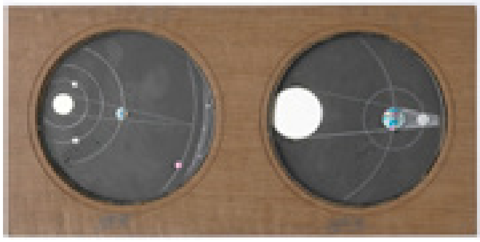
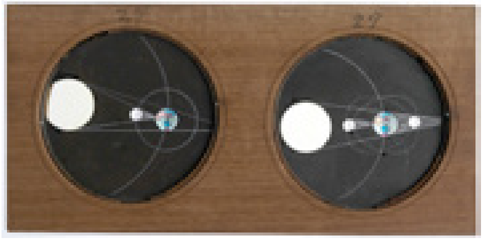
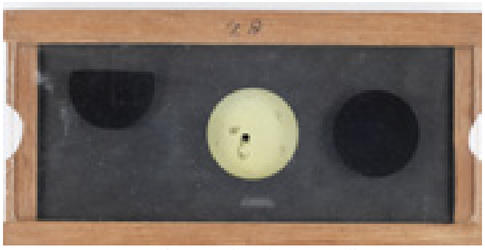
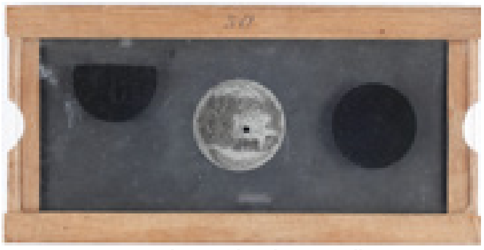
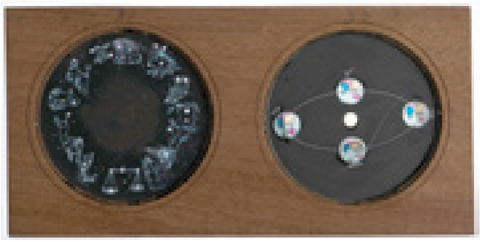
 1: Figure of the Earth & 3: Full Moon	 2: Rotundity of the Earth (animated)
 4: Half Moon & 5: Crescented Moon	 6: Moon's Phases & 7: The Sun
 8, 9: Mercury & Venus & 10: Mars	 11: Asteroids & 12: Jupiter
 13: Saturn & 14: Saturn (edge on)	 15: Uranus & 16: Neptune
 17: Comet Orbit & 18: Comet of 1680	 19: Comet of 1811 & 20: Ptolemaic

Table 4.1 ‘Popular Lecture on Astronomy’ Slide Set (continued)

 21: Copernican & 22: Tychonic	 23: Newtonian & 24: Earth’s Shadow
 25: Earth’s Shadow & 26: Eclipse	 27: Eclipse of Sun & 29: Moon Orbit
 28: Solar eclipse (animated)	 30: Lunar eclipse (animated)
 31: Zodiac & 32: Seasons	 33: Spring tides & 34: Spring tides
 35: Neap tides & 36: Orion	 37: Ursa Major & 38: Milky Way & Nebulae

Source: Museum Victoria collection

4.2.3: The photographic lantern slide

The shift away from the older style of lantern slide occurred in parallel with another important change at the end of the nineteenth century: the development of photographic techniques in the production of lantern slide images. This had a range of effects. On the one hand it increasingly brought the production of good quality images within the reach of the amateur. On the other hand, professional scientists and popularizers also used photographic technology to enhance the authority for their own presentations. Popular astronomers had long spoken of—and for—the past; now they could claim to speak of the future as well. The images they were now deploying, suggested pioneering British astrophotographer Andrew Ainslie Common, would "not be the written impression of dead men's views" but the records of the future astronomer, the heavens "as they existed".[504] While these changes intersect weakly with the major case studies of this thesis, they are important for changes the broader understanding of science, visuality and society and so I will briefly outline them here.

The astronomical applications of photography began almost with the technology itself. The very word photography was invented by one astronomer—the German Johann Heinrich von Mädler—and popularized by another—the British John Herschel. Famously Louis Daguerre took an image of the Moon in 1839 while still developing his process, and was quickly followed by others including John Draper in the USA in 1840. Astronomical photography took a little longer to get started in Australia but by the 1870s both Ellery at the Melbourne Observatory and Russell at the Sydney Observatory were advocates of photographic techniques. That decade saw the 1874 Transit of Venus at which photographic techniques were deployed in a major way. While the results internationally were considered disappointing, Russell claimed his photographs "to be the best and most complete".[505] The Sydney astronomer went on to be recognised as an authority,

[504] 'Photography', *Australian Town and Country Journal*, 13 Nov. 1886, p. 33.

[505] 'Royal Society. Astronomical Observations and Instruments', *Sydney Mail and New South Wales Advertiser*, 13 Nov. 1875, p. 6.

publishing a number of papers on the subject.[506] By the 1890s Ellery and Russell had been joined by R. F. Griffiths of the Adelaide Observatory as a local expert.[507]

Photographic techniques for lantern slides began almost as quickly as astrophotography. Slides were produced photographically from the late 1840s. This application of photography did reach Australia quickly; by 1853 photographic slides were advertised in Sydney.[508] Of course existing technology—the chromotrope—was advertised alongside the new; the significance of emerging technologies is rarely apparent at their commencement but rather it is the comparison to the old that is most frequently made at the time.

The technologies of photography were soon available for the enthusiastic amateur in Australia but it took time for them to spread, and it was not until the introduction of Kodak cameras that photography truly became a mass practice. Nonetheless, photographic slides were already a dominant form by the time of Pepper and Proctor's tours in 1880. Photographic firms had started appearing in Australian cities in the 1870s and were widespread by the 1890s.

The effects of photographic reproduction of lantern images were many. Hartrick lists:

> the expansion of the content of the slides; the versatility of either reproducing graphic images or projecting photographic images; and the ease, speed and greatly reduced cost of production of slides[509]

The rise of the photographic lantern slide over the earlier illustrative sets also reflected the shift in visual epistemology described by Daston and Galison from truth-to-nature, wherein images were drawn to illustrate ideal types and significant features, to mechanical objectivity where images were expected to show objects as they truly were.

---

[506] Russell, *The Progress of Astronomical Photography*, 1893.

[507] 'Astronomical Photography', *Advertiser*, 23 Jul. 1901, p. 6.

[508] 'Advertising. Stereoscopes', *Sydney Morning Herald*, 5 Nov. 1853, p. 8.

[509] Hartrick, 'Consuming Illusions', PhD thesis, 2003, pp. 74–75.

Indeed, this was true of photographic techniques applied more generally to scientific work.

> Over the course of the nineteenth century other scientists—from botanists to zoocrystallographers, from astronomers probing the large to physicists poring over the small—began questioning their own disciplinary traditions of idealizing representation in preparing durable compendiums of images. … Emphasizing a proud epistemic, even metaphysical idea, this widening circle of scientists relegated perfection to a chapter in the history of subjective error. Where the eye of the mind had dominated with its reasoned sight, blind sight now contested the rule. [510]

Of course, as Dalton and Galison themselves note, such a periodization should not be seen as absolute. As noted in §4.2.2, the older style lantern set survived until the end of the nineteenth century and beyond, while aspects of Proctor's performance in particular represented not just mechanical objectivity but also Dalton and Galison's later stage of trained judgement. In this context it is remarkable how durable were the 'notation' of astronomical diagrams and their embodiment of 'truth to nature'. As late as 1924, in a British catalogue of scientific lantern slides in which nearly every other scientific image is photographic, an old style of mechanical astronomical lantern slides is still advertised.[511] The schema of astronomy as an exemplary science with a precise mathematical form continued to involve the use of diagrammatic images beyond that of other sciences.

Nonetheless, the advantages of photography for astronomy advanced by Common clearly lie within the framework of mechanical objectivity. Beside these grandiose claims, this framework promised more subtle benefits of photography as well. One recurring theme in the application of photography to scientific work in this period was to enable things previously unseen to be brought into view. “By the aid of photography, within a year or

[510] Daston and Galison, *Objectivity*, 2007, p. 160.

[511] *Lantern Slides Illustrating Zoology, Botany, Geology, Astronomy, Textiles &c.*, 1924.

two, for instance, millions of new stars, invisible, and far beyond the ken of any telescope yet built, have been discovered."[512]

These photographic images of astronomy were well taken up by popularizers and educators. The old-style lantern set referred to above is interesting but is certainly an outlier; teaching sets of astronomy, including those used at the Sydney and Melbourne Observatories in the 1890s and 1900s[513] were primarily photographic in nature.

This shift in visual authority for the photographic astronomical image was also consistent with ideas about entertainment in modern urban societies. The use of photographic techniques in lantern practice also foreshadowed the use of photographic imagery within cinema, although the production model would be very different for the latter, especially after the actuality cinema era. The multiple motivations of Australian elite astronomers will be described further in Chapter 5.

[512] 'New Telescopes', *Launceston Examiner*, 3 Apr. 1897, p. 14.

[513] These sets are held by the Museum of Applied Arts and Sciences and Museum Victoria respectively.

4.2.4 Memories of lantern culture

The magic lantern was a crucial technology for popular astronomy in the nineteenth century. It could mean many things. In the hands of an expert, like Richard Proctor, it was a window onto the universe. In the wrong hands it could be, as Charles Dickens described, "a slow torture".[514] Understanding the lifecycle of the technology, and how it shaped and was shaped by audience experience, allows us to better comprehend the way astronomical popularization did, or did not, work.

A theme running through the previous sections is the change over time in expectations of audiences as they grew more familiar with the magic lantern, both as a show and as a performance. This expectation relies crucially on memory, that is the memories of earlier experiences with the technology. It is a basic observation in cultural history to note that memory is socially constructed; people remember when things are talked about.[515] It is one of the powers of popular media that they are able to powerfully generate such conversations of shared experiences and hence social memories.

The formation of expectations about technological performances in childhood appears to be particularly strong. One example of this is that at least some adults in the 1920s and 30s consciously reflected on their experiences of lantern technology as children in the 1880s and 90s in attempts to revive lanternism.[516]

Children were certainly a major audience for lanternists. By the 1880s the presence of small children in public spaces was greater in Australia than it was in Britain, at least for the middle and upper classes[517] but mentions of children at lantern performances in Australia are extremely common from well before this. Charles Price in Launceston in 1845, Mr Robinson in Sydney in 1856, Dr Thornton in Muswell Brook in 1858, Arthur

[514] Dickens, *The Complete Works of Charles Dickens*, 2009, pp. 193–94.

[515] Connerton, *How Societies Remember*, 1989.

[516] 'The Old Magic Lantern', *Williamstown Chronicle*, 31 Jan. 1931, p. 2.

[517] Twopeny, *Town Life in Australia*, 1883, p. 82.

Hodgson's lecture in Sydney in 1861 are just some of the astronomical lectures in which the presence of children is emphasized, and aspects of the lecture structured around the children are described. This includes lectures at otherwise adult venues such as Mechanics' Institutes, where children were present:

> At the conclusion of his discourse, the Lecturer entertained the company with a succession of grotesque pictures, such as are usually exhibited by aid of the Magic Lanthorn. By this the little children were thrown into ecstasies of delight, and, no doubt, speedily forgot all that they had heard about Astronomy, in the pleasure occasioned by the sight of dancing puppets. However we shall not quarrel with this attempt to blend amusement with instruction, but would rather advise the Lecturer in future not to forget his phantasmagorial apparatus, whenever it may be his wish to secure a large juvenile attendance. If properly managed, it might, in due time, became almost as popular as under such circumstances, might become a source of much profit to the institute.[518]

as well as those at more juvenile ones, like schoolrooms, where adults were also in attendance:

> The life and adventures of Tom Thumb and his little wife, illustrated by magic-lantern diagrams, was very amusing, and caused much merriment amongst the juveniles.[519]

Children's response to magic lantern shows was no more uniform than that of adults. More than one report echoes the complaints about the "half civilized" boys of Gawler Town who, during the Rev G. D. Mudie's lecture, took advantage of the darkness to indulge "in the most noisy and disgraceful conduct".[520] Nearly 80 years later a correspondent for the *Age* would recall that "Most children had a deep-seated aversion to

[518] 'Mechanics' Institute. The Rev C Price's Lecture', *Cornwall Chronicle*, 10 May 1845, p. 2.

[519] 'Glenburn September 20', *South Australian Chronicle and Weekly Mail*, 24 Sep. 1870, p. 7.

[520] 'Gawler Town', *Adelaide Observer*, 11 Sep. 1858, p. 4.

the ‘magic lantern’, failing to see any magic about it, and hating the horrible vague images, often upside-down”.[521]

Other memories, of course, were more kind. In 1921, late in his life, South Australian Wal Tumba recalling the 1870s said:

> When I was a small boy the magic lantern was a popular form of amusement. I can remember having been taken, on one occasion, in company with my brother and sister, by my parents to Strathalbyn, for the purpose of attending a magic lantern entertainment. This little jaunt involved a journey of 12 miles, including return. We were conveyed in a heavy dray drawn by one horse. There were no motor cars in those days, and buggies were seldom seen. It was a dark night, and we travelled along a rough road through heavily timbered country. I don't remember what our elders thought of the show, but we youngsters thought it simply wonderful. One picture made a great impression on my mind. A man was lying on bed. His lips opened wide apart, where, lo! and behold a daring little mouse appeared on the scene, and without hesitation boldly slipped inside the cavernous mouth. Whether he was in search of a supper or if some other motive prompted him to make this daring invasion, was not apparent, but to my youthful mind the fearless manner in which he glided in and out was simply amazing. There were one or two other 'moving pictures' of lesser importance, for the mouse performed the star turn that evening. When I left the hall I determined that when grown to man and estate I would become the proprietor of a magic lantern picture show, in order to travel and exhibit in different towns to audiences principally composed of little boys and girls.[522]

The ‘sleeping man eating a rat’ animated slide was a mainstay of comic lantern slide lectures (see Figure 4.6) but nonetheless that a specific image could hold its place in Tumba’s memory for so many decades speaks to the emotional appeal of the performance. The social memory of the magic lantern show existed as a real force.

[521] ‘The Lantern Slide’, *Age*, 30 Jan. 1937, p. 6.

[522] Tumba, ‘Reminiscences. Old-Time Entertainments’, *Register*, 30 Jul. 1921, p. 12.

By the late nineteenth century the astronomical lantern show had stabilised in both form and content. This stabilisation clearly shaped the expectations of its audiences.

By 1900 not only had the expectations and experiences of children changed, so too had social conditions with Australia a more urbanised and industrialised society, and with a more diverse, and stratified cultural domain. This is the context, the lantern was starting to seem positively old-fashioned. Even professional lantern operators would observe this:

> What child of five, having once seen a good animated photograph show, is content with the too often ridiculous action of a lever or slipping slide? And the same may be said of children of older growth. The truth is, these things have been with us too long.[523]

The death of technological forms has traditionally been subjected to much less scholarly attention than their births but Natale and Balbi's 'Imaginary of Old Media' is clearly significant[524] in relationship to the magic lantern. The lantern slide may have 'been with us too long' but it shaped a screen culture amongst nineteenth century audiences and thus influenced early film audiences and practitioners. The under-acknowledged continuities between lanterns and cinema have already been described. It is common for both practitioners and audiences at this time to describe the cinema technology as a form of magic lantern.[525] Nor was the need to innovate in terms of content lost on early pioneers of film.[526]

In the very late 19th century, just as the social and technical bases for the lantern show were fragmenting under the pressures of cinema technologies, new social bases of authority and changing demographics, the memory of the lantern became stabilised, first

523 Sanders, 'The Decline of Lantern Views', *The Optical Magic Lantern Journal and Photographic Enlarger*, Apr. 1900, 48.

524 Natale and Balbi, 'Media and the Imaginary in History', *Media History*, 2014, 203–18.

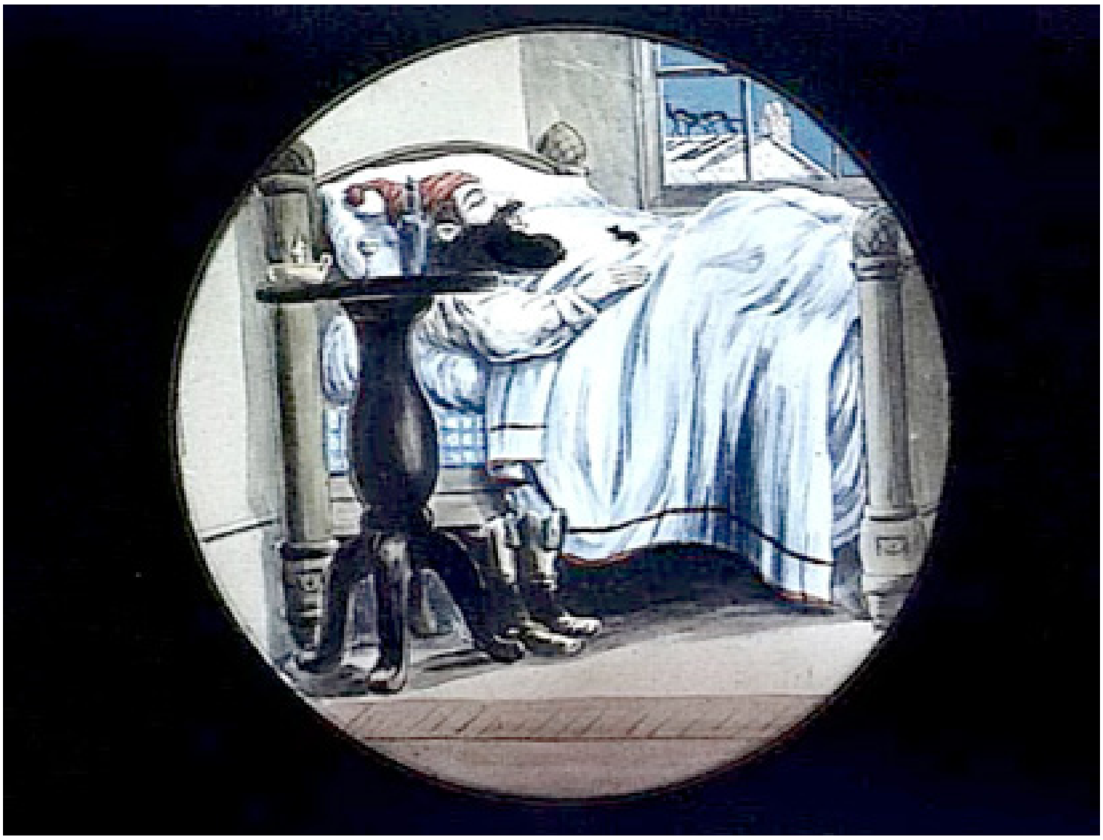
525 eg Spencer and Waley, *The Cinema Today*, 1956, p. 1.

526 Gunning, *D.W. Griffith and the Origins of American Narrative Film*, 1994.

just as ‘the magic lantern show’ and then eventually as ‘the old-time magic lantern show’ before dropping out of cultural memory almost entirely.

The memory of the magic lantern appears here like Law’s Portuguese ships: “unbroken if it is sustained within a stable network of relations with other entities”[527] and disappearing when that network of relations breaks down. The astronomical lantern show was supported for many decades by an alliance between the demographics of colonial society, the technology and trade of lantern slides, the social disposition of authority and the cultural schemata of astronomy. This points to an aspect of schemata that has been emphasized throughout this thesis: they gain their utility through an association of otherwise unrelated ideas, and that their strength comes from the persistence of this organization. For the lantern show the association between visual technology, the experience of childhood and the social relationships involved in that experience was able to create a memory strong enough to be deployed many years later.

[527] Law, ‘Objects and Spaces’, *Theory, Culture & Society*, 2002, 91–105.



Source: Museum Victoria MM31815

Figure 4.6 Comic slide, sleeping man eats rat

Humourous slides were a mainstay of magic lantern performances, especially those oriented towards children. This image is of an animated slide. When operated, the sleeping man's mouth opens and shuts, and a rat climbs up the bed and into the man's mouth.

South Australian resident Wal Tumba, writing in 1921, was able to remember a slide such as this after an interval of more than 40 years. The specific recall of such a specific image attests to the power of the visual communication.

4.3 Astronomical devices

The previous section described various relationships between the practices of popular astronomy and materiality. I have suggested both that the material aspects of visual practice were significant, and that the cultural schemata deployed by popularizers can be thought of as analogous to materiality. In this context, it is worth noting that *very* material devices such as orreries and related instruments were also associated with popular astronomy. Although the tradition of material displays and exhibitions was never as prominent in Australia as it was in Britain, they were nonetheless present.

An orrery is a mechanical representation of the solar system, showing the planets orbiting the Sun at varying speeds; related devices are tellurians, showing the orbit of the Earth around the Sun, and lunariums, showing the orbit of the Moon around the Earth. Orreries date to the early 18th century and take their name from Charles Boyle, the Fourth Earl of Orrery for whom an early example was made, although the invention of the device is credited to George Graham, a watchmaker.[528]

The first orrery known in Australia was constructed in 1834 by "Mr Cox, a young mechanic recently arrived in the Colony".[529] The device appears to have been a "transparent orrery"[530] that is to say a small vertical device that when illuminated could project the animated motions of the planets onto a nearby wall or screen. (In this it was related to the orrery slides described earlier although the larger physical size meant that the mechanisms could be considerably less intricate.) However other reports emphasize

[528] Bush, 'Orrery', 2004, p. 13.

[529] 'Sydney Mechanics School of Arts', *Sydney Monitor*, 7 Feb. 1835, p. 2.

[530] 'Advance Australia', *Sydney Gazette and New South Wales Advertiser*, 20 Dec. 1834, p. 2.

the mechanical aspects of the device, including that it could require repair.[531] Considering both of these reports, it is likely that Cox's device was similar to the Keevil slide, which is dated from around the same period. (see Figure 4.7)

The construction and display of orreries accentuated some associations of visuality with astronomy. The physical construction of an orrery demonstrated a technical mastery over clockwork mechanisms that implied an understanding of the clockworks of the heavens even more than the lantern suggested control over vision. The physical motion of the components of the orrery presented a geometrical and mathematically ideal picture of astronomical science, far beyond what could be philosophically maintained, but which was influential nonetheless. As previously, these ideas about the exemplary science carried moral force. One observer of Cox's orrery would go so far as to declare that "The introduction of a grand Orrery amongst us, is no short stop to the advancing Australia, in moral and intellectual acquirements".[532]

However the greater material investment in the construction and trade in orreries and related devices did not just stimulate the second, it also highlighted the first pole of Huang's description of "The commercial and the sublime".[533] These complicated technologies promised an experience more rare and, potentially, even more engaging than a set of lantern slides, and were thus appealing to entrepreneurs. These arrangements of apparatus also helped to create the cultural space of popular science. According to Huang: "The development of astronomical visual aids in the nineteenth century exemplified the disagreement between scientific elites and commercial entrepreneurs".[534]

Cox, with the first known orrery in Australia, is one such example but far from the only one. Indeed his was not the first orrery discussed in Australia. In 1830, the colourful

[531] 'To the Editor of the Sydney Monitor', *Sydney Monitor*, 6 Dec. 1834, p. 3.

[532] A Lover of Research, 'Original Correspondence. School of Arts', *Sydney Herald*, 27 Oct. 1834, p. 3.

[533] Huang, 'Commercial and Sublime', PhD thesis, 2015.

[534] Ibid., p. 201.

Laurence Hynes Halloran[535] solicited subscriptions for a series of public lectures. Jailed at 18 for stabbing a shipmate, insolvent at 31 after a failed school and ruined again at 45 after having published defamatory verse in Cape Town, Halloran had been transported to Australia, age 53, for forging credentials as a curate. He was granted a ticket-of-leave by Governor Macquarie and briefly found success as a schoolmaster before further legal actions landed upon him. "From year to year he was forced to move his school to escape his creditors, and a series of libel suits and several periods of imprisonment for debt reduced him to beggary."[536] By the time the 1830 lecture series was advertised Halloran had opened and closed another school, founded a newspaper that folded—under the weight of defamation actions—and been appointed Coroner, but quickly dismissed, again, for potential libels. He died shortly afterwards, aged 66.

Halloran's lecture series was to be on the British Constitution. However, should this be successful, he proposed for a second series "to procure from England, with the least possible delay, an Eidouranion or Orrery for the purpose of introducing Lectures on Astronomy, and of encouraging among the youth of the Colony, a taste for that sublime science".[537] Spectacular and rare astronomical displays appeared as a financial gambit by a down-on-their-luck member of the educated classes for the first time in Australian history.

Astronomical displays as a means of making money were tried not just by schoolteachers and scientists but also by people from a theatrical background. One of the best examples for this is John Meredith, one of the early pioneers of theatre in Australia, who would also invoke the reputation of the Eidouranion to bolster his performance. Renowned predominantly as a comic actor, Meredith played many parts, although there were some that he would not accept: a court action between him and former friend Joseph Wyatt occurred after Meredith was dismissed for refusing to play the part of Hintz Jacob.

---

[535] Austin, 'Halloran, Laurence Hynes (1765–1831)', 1966.

[536] Ibid.

[537] Halloran, 'Public Lectures', *Australian*, 30 Jul. 1830, p. 2.

Meredith argued that Wyatt reneged on a contract to appoint Meredith as manager, persuaded the jury and won the case.[538] Nonetheless, by 1840 he was insolvent and died intestate in 1852, aged 51, leaving "Chests of books, maps, wearing apparel, and sundries".[539]

Both in 1837—before his insolvency—and in 1842—after—Meredith advertised a series of astronomical lectures entitled "Dioastrodoxon, or, the heavens displayed".[540] These lectures would

> explain the various phenomena of the Heavens, together with an illustration by transparent diagrams, and a working Orrery, made by himself expressly for the occasion, after the manner of Walker's highly celebrated EIDOURANION.[541]

Walker's Eidouranion, along with Lloyd's Astrodioxon, Prior's Astronomicon and Adam's Orrery were large stage devices, ten metres or more across, displaying astronomical motions. As Huang says, "By presenting scenic effects, these large machines added elements of theatricality into astronomy lectures"[542] in a competitive entertainment market in London. Huang draws attention to the fact that British astronomical lecturers included both those with backgrounds as former schoolteachers and those from the theatre. It is notable that similar lecturers were seen in Australia at the same time.

Recent literature has questioned whether the Eidouranion and related devices were mechanical in nature or large projections,[543] although the 1840 article by George William Francis (later director of the Botanical Gardens in Adelaide, prominent member of the

[538] 'Supreme Court', *Sydney Gazette and New South Wales Advertiser*, 9 Jul. 1839, p. 2.

[539] 'Advertising', *Sydney Morning Herald*, 11 Nov. 1852, p. 4.

[540] 'Dioastrodoxon or the Heavens Displayed', *Colonial Times*, 29 Aug. 1837, p. 2.

[541] Ibid.

[542] Huang, 'Commercial and Sublime', PhD thesis, 2015, p. 232.

[543] Ibid., p. 228; Bird, 'Enlightenment and Entertainment: The Magic Lantern in Late 18th- and Early 19th-Century Madrid', 2005, pp. 86–91 (pp. 90–91); King and Millburn, *Geared to the Stars*, 1978, p. 310.

South Australian Institute, and popular lecturer) in the *Magazine of Science* seems to make it clear that at least some of the devices of that era were mechanical instruments operated by rackwork and cords revolving an internally illuminated globe around a frame of back-lit transparencies.[544] (See Figure 4.8.) The copying of ideas, pictures, devices and names was common in this trade, making it difficult to trace the stability of any particular designation: any of these may have been a projection in one performance and a mechanical device in another, even by the same presenter.

Whatever the nature of the original Eidouranion, it would appear that Meredith was taking a rather theatrical licence with his use of the term. The description of Meredith's performance Part 1 being "Ptolemy, with diagram of his system: from Ptolemy to Copernicus, with his system: from Copernicus to Tycho Brahe, with diagram of his system" and Part 2 "The sun, his motion, spots, &c.; a description of the planets, with their several telescopic appearances illustrated by diagrams; the Ecliptic; the earth; its sphericity; its diurnal and annual motions; comets; the zodiac; the seasons"[545] interspersed by the Orrery sounds like a standard set of lantern slides, albeit that such a set would have been a novelty in the colonies at this time. While projection devices, like Cox's, had already been produced, Meredith's claim that his Eidouranion was "made by himself"[546] suggests that it was not an intricately geared projection mechanism.

Meredith's endeavours were more successful than either Halloran's or Cox's—he was able to present at least two seasons of his Dioastrodoxon, separated by five years—but neither run was particularly long. Commercial lecturing in general, including those based around the more common technology of the lantern slide, was not very successful before the appearance of Pepper and Proctor. Francis Low in Tasmania, and James Allen in South Australia are two examples from the 1840s of attempts to run such a commercial display of astronomical slides; again, neither lasted long. With small local markets, the audiences

544 'Astronomical Illustrations', *The Magazine of Science and School of Arts*, 4 Apr. 1840, 1–3.

545 'Advertising. Astronomical Lectures at the Royal Hotel', *Sydney Morning Herald*, 31 Dec. 1842, p. 3.

546 'Dioastrodoxon or the Heavens Displayed', *Colonial Times*, 29 Aug. 1837, p. 2.

for a commercial show in any given town were quickly exhausted, while the distances in Australia made travelling difficult. As Hartrick documents, it was not until the 1870s that the itinerant commercial lanternist—common in Britain throughout the nineteenth century—would be seen in Australia.

Another way that mechanical displays were both related to but differed from more visual forms was their involvement in exhibition contexts. The change in cultural status of astronomy is particularly stark in this history. Australian colonial societies largely lacked the large-scale exhibitions that were common in London at this time. The early Australian museums, such as the Australian Museum in Sydney and the National Museum of Victoria concentrated on natural history and anthropological collections. Although the latter institution did include a significant collection of mining models, it was not until the establishment of the Industrial and Technological Museum in 1870 that scientific instrumentation display equipment had an institutional home. Even then, it was not until well into the 20th century, with the foundation of the HV McKay Planetarium, that popular astronomy held a permanent place here (although astronomers like Robert Ellery did give frequent lectures at the Museum from its inception, as will be discussed in § 5.4.) Sydney's Technological Museum preceded that of Melbourne by seven years, but was no more successful in providing a permanent display of astronomical material.

There were, however, a number of exhibitions both commercial and sublime that preceded the Technological Museums in the Australian colonies. As with the commercial lecturers described in this section, none of the commercial exhibitors proved especially successful—but they provide further examples of the ways in which astronomy operated within popular culture and the different traditions—educational and theatrical—that it drew upon in order to do so.

In Sydney, James Smith Norrie opened the Royal Polytechnic in 1854. Born in London and trained as a chemist, Norrie arrived in Australia in 1840. He was the first government chemist appointed in New South Wales, appointed in 1844. This was done on a fee-for-service basis, and Norrie maintained business interests outside of his government work, running a chemist store in Pitt Street.[547] By 1844, Norrie had already known financial hardship: he was declared insolvent in 1843, as he would be again in 1874, just after his retirement from his government position in 1871.[548]

Both Norrie's advertising, and most reports of the Royal Polytechnic focus on the range of dissolving views and chromatropes displayed. Norrie was reported to have on hand "a quantity of expensive apparatus calculated to illustrate almost every branch of natural philosophy" but was unable to "bring them into operation from want of the proper support of the public".[549]

One piece of equipment that Norrie did deploy was the "immense orrery".[550] Originally announced with the opening of the Royal Polytechnic, in March 1854, it was not until eight weeks later that the lectures in astronomy commenced on the 3rd May. Like Halloran and Meredith before him, Norrie associated his device with one of the London showmen of astronomy, in this case Charles Henry Adams, the longstanding British astronomical lecturer who was described by one periodical as "the only orthodox interpreter of astronomy".[551] A review of Norrie's lecture described it as "lucid and comprehensive"[552] and also made its physical form clear. These were displays on canvas; Norrie was presenting an orrery slide, readily available by 1854, projected by a lantern.

A mechanical orrery—also known as a planetarium—was part of the Melbourne Polytechnic Institute established by Melbourne doctor Louis Lawrence Smith[553] in 1862. A contemporary example of such a device is shown in Figure 4.9. At its opening the *Leader*

[547] 'Presidential Address', *Journal and Proceedings of the Royal Society of New South Wales*, 1904, 1–20.

[548] 'Insolvency Business', *Australasian Chronicle*, 2 Aug. 1843, p. 3; 'Insolvency Court', *Sydney Mail and New South Wales Advertiser*, 13 Jun. 1874, p. 762.

[549] 'Royal Polytechnic', *Sydney Morning Herald*, 3 Feb. 1855, p. 5.

[550] 'Advertising. Royal Polytechnic Exhibition', *Sydney Morning Herald*, 20 Feb. 1854, p. 2; 'Advertising. Royal Polytechnic', *Empire*, 15 Jun. 1854, p. 1.

[551] '(No Title)', *Era*, 23 May 1856.

[552] 'The Royal Polytechnic', *Empire*, 2 Jun. 1854, p. 2.

[553] Featherstone, 'Smith, Louis Lawrence (1830–1910)'.

noted that "The planetarium also found admirers, but this was an instrument rather too abstruse to be generally appreciated".[554] Notably, this device was also explicitly considered to be suitable for children, as were astronomical lantern slides: "a small planetarium, in which a portion of the solar system is correctly represented, commends itself to the attention of those who desire to improve the situation with the young".[555]

Smith was another larger-than-life entrepreneur. The Polytechnic Institute was founded very much as a money-making 'spec'.[556] Poynter draws attention to the possible influence of his showman father on prompting this line of business,[557] another reminder of the theatrical influence on popular exhibitions and lectures. A medical doctor, Smith's Polytechnic Institute incorporated an anatomical museum "of which there were several in Melbourne"[558] already at this time, but whose function in this establishment was also to help promote his more lucrative practice. This aspect, Smith appears to have regarded as a success,[559] but overall the Polytechnic was a financial failure and closed in 1864.[560] According to Dunstan this was due to "Public disapproval of the more graphic displays and high admission prices"[561] although the internal operations of the Polytechnic were not completely smooth either: in early 1863, not long after the opening, two of the Polytechnic lecturers, the analytical chemist William Sydney Gibbons and medical doctor Edward Bowman ended up in court after a "brawl arose from some remarks made by Mr Gibbons disparaging Dr Bowman's lecturing qualifications".[562] While Smith may personally have enjoyed the notoriety, such an event cannot have endeared his Institute to the respectable middle-classes.

[554] 'Opening of the Polytechnic Institute', *Leader*, 27 Dec. 1862, p. 12.

[555] 'The Polytechnic Institute', *Argus*, 10 Jun. 1863, p. 5.

[556] Poynter, *The Audacious Adventures of Dr Louis Laurence Smith*, 2013, pp. 237–38.

[557] Ibid., p. 238.

[558] Ibid., p. 248.

[559] Ibid., p. 250.

[560] Ibid., pp. 252–55.

[561] Dunstan, 'Exhibitionary Complex Personified: Melbourne's Nineteenth Century Displays and the Mercurial Dr L L Smith', 2008, p. 9.1-9.18.

[562] 'Current Topics', *Geelong Advertiser*, 26 Jan. 1863, p. 2.

A third example in this genre was Thomas Spencer's Royal Polytechnic, opened in Pitt Street in Sydney in October 1870. Unlike the other exhibitions, astronomy played no part in Spencer's Polytechnic which consisted primarily of mechanical devices constructed by Spencer himself (originally for display at his hotel The Shakespeare), along with a series of waxworks and some larger models.[563] This was taken over by theatrical performer Aspinall Thiodon in 1878. While Thiodon added some items to the exhibition, he also enhanced the nightly entertainments, in particular with illusionist shows by his son Thomas Aspinall. The new Polytechnic was reportedly successful but by August 1881 ill health caused Thiodon to retire from the business and sell the collection.[564] Some of these items turned up in yet another Royal Polytechnic, operated by Alfred Cane in George Street from 1886, but this too soon became primarily a venue for performance, as had by this time the Melbourne Polytechnic Institute, which had also gone through a series of proprietors. The decline of the prominence of astronomy within these institutions thus mirrored the decline in the educational focus of the institutions themselves.

A final set of exhibitions worth noting were the official intercolonial and international ones. The Intercolonial Exhibition of 1866, the International Exhibition of 1880 and the Centennial Exhibition of 1888, all in Melbourne, focused on the products of local industry. Scientific instrumentation was not well represented in any of these, but the Centennial Exhibition did contain a set of model solar system objects to scale, designed by Robert Ellery.[565] Mirroring the shift in the base of authority in science itself, the promotion of popular science had moved away from the versatile entrepreneur to the government astronomer. This theme will be taken up again in Chapter 5.

Exhibitions of mechanical devices of astronomy spanned the range of motivations from 'commercial to sublime'. Just as the form of the lantern slide emphasized particular aspects of knowledge practices, so did devices throw these motivations into sharper relief,

[563] 'Spencer's Royal Polytechnic', *Illustrated Sydney News and New South Wales Agriculturalist and Grazier*, 21 Dec. 1872, p. 2; 'Colonial Art', *Bell's Life in Sydney and Sporting Chronicle*, 9 Oct. 1869, p. 3.

[564] Bradshaw, 'Thiodon's Wonders', *Australasian Drama Studies*, 2007, 18.

[565] 'Australasian Courts. Victoria', *Weekly Times*, 4 Aug. 1888, p. 12.

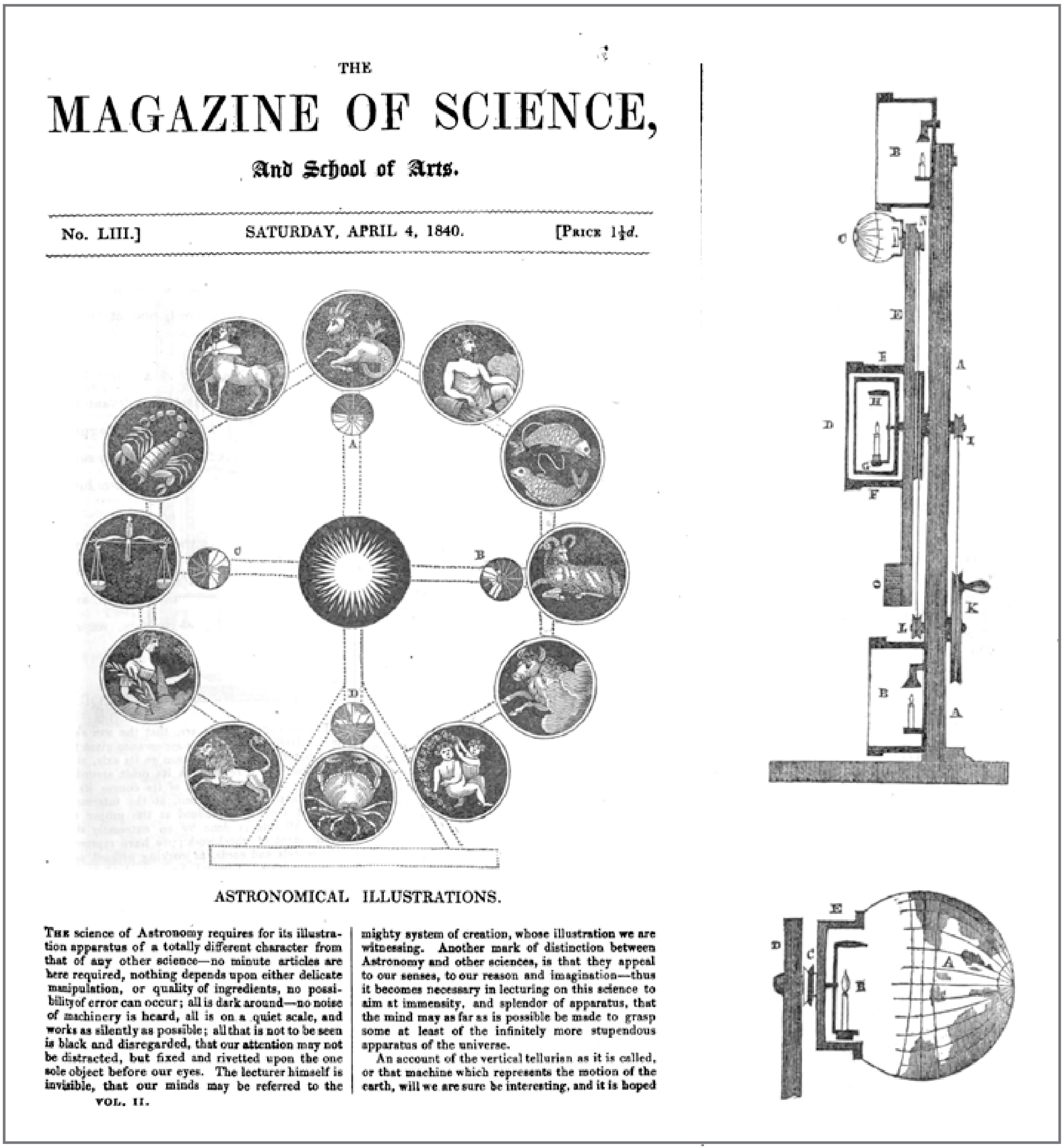
in large part because of the greater coordination of people and places required. The theatrical background, crucial for understanding Richard Proctor's success, is seen to be of fundamentally importance for popularization, not just an incidental piece of context.

Source: Science Museum, London Object 1902-104

Figure 4.7 Keevil mechanical solar system, 1838

This large mechanical transparency was used to project a view of the solar system onto a wall. The device could be operated, showing the motion of the planets. This particular model was used by Mr G M Keevil in 1838. Soon afterwards mechanical slides like this would be made smaller and become part of commercially manufactured sets from firms such as Carpenter and Westley, and Newton.

The first orrery known in Australia was built by a Mr Cox in 1834. It is reported as having both complicated mechanical parts, and being capable of projecting images. As such it was very likely a device of a similar type to the Keevil slide.



THE

MAGAZINE OF SCIENCE,

And School of Arts.

No. LIII.] SATURDAY, APRIL 4, 1840. [Price 1½d.

ASTRONOMICAL ILLUSTRATIONS.

The science of Astronomy requires for its illustration apparatus of a totally different character from that of any other science—no minute articles are here required, nothing depends upon either delicate manipulation, or quality of ingredients, no possibility of error can occur; all is dark around—no noise of machinery is heard, all is on a quiet scale, and works as silently as possible; all that is not to be seen is black and disregarded, that our attention may not be distracted, but fixed and rivetted upon the one sole object before our eyes. The lecturer himself is invisible, that our minds may be referred to the mighty system of creation, whose illustration we are witnessing. Another mark of distinction between Astronomy and other sciences, is that they appeal to our senses, to our reason and imagination—thus it becomes necessary in lecturing on this science to aim at immensity, and splendor of apparatus, that the mind may as far as is possible be made to grasp some at least of the infinitely more stupendous apparatus of the universe.

An account of the vertical tellurian as it is called, or that machine which represents the motion of the earth, will we are sure be interesting, and it is hoped

VOL. II.

Source: Internet Archive

Figure 4.8 Vertical tellurian diagram, 1840

The *Magazine of Science and School of Arts* of 4 April 1840 contained this article with a construction diagram for a ‘vertical tellurian’. Such devices had been a spectacular part of theatrical astronomy since the 1780s, under names such as the Eidouranion or Dioastrodoxon. However no traces of these devices has remained, and their precise nature has remained unclear.

This article apears to establish that these devices involved backlit transparencies moved by a mechanical framework.

Source: Science Museum, London, Object 1950-55

Figure 4.9 Orrery, William Pearson, 1813

An orrery is a mechanical model of the solar system. Constructing a machine like this emphasised both the ideal nature of astronomy as a science, and mastery of humans over these laws. It thus emphasized the cultural schema of astronomy as an exemplary science.

This orrery was designed by William Pearson and constructed by London instrument maker Robert Fidler. It combined the features of several other forms of orrery—a grand orrery showing the motions of all of the planets out to Uranus, a Jovian machine showing the motion of the satellites of Jupiter, and a tellurian and lunarium showing the motions of the Earth and Moon. Orreries were present in Australia from the 1830s onwards, although this model was more complicated than anything seen in the colonies.

4.4 Astronomy in print

Exhibitions provided a dramatic staging while lantern practice provided spectacular imagery; both of these were high-impact media. However the most widespread way in which object and image came together throughout the historical period of interest is in the medium of print. These sources have been crucial to this study. Newspapers have been referred to throughout, while lectures printed in pamphlet form were significant both in relation to Proctor's tour, described in §§ 3.2–3 and with respect to Mechanics' Institutes, in § 2.6. Almanacs, one of the most significant and most forgotten printed forms of the late eighteenth and early nineteenth centuries were also discussed in § 2.4. This section will turn to a brief discussion of the various forms of print and how they operated as a material technology for the circulation of astronomical ideas.

4.4.1 Newspapers and weeklies

Richard Twopeny's description of Australia as the 'land of newspapers' was given in § 1.5, as was a discussion of the reasons for this, including relatively high literacy and incomes. Certainly newspapers were an important source of public culture in colonial Australia.

Early colonial newspapers, such as the *Sydney Gazette* and the *Colonial Times* were generally dailies or bi-weeklies but by the latter half of the nineteenth century Australian newspapers came in three definite types: dailies, weeklies and illustrated monthlies. The major factors in this arrangement were the combination of printing technologies and a dispersed market.

Daily papers would provide a report of the news and were typically eight pages long—although a number of titles would issue supplementary sections when ships arrived in port bearing news from Europe. These newspapers were the major means by which colonials received information about 'home'. Weekly newspapers, like the *Australasian* and the *Town and Country Journal* would summarise the weeks news, as well as printing fiction. They also carried columns on literary and scientific topics; these papers were thus one of the major sources for popular science. Weekly papers were especially prominent in rural areas where the cost of distributing a daily paper was prohibitive but were also important for working-class urban readers who would prefer to buy one paper a week. Monthly illustrated papers arose in Australia in the 1850s after initial attempts to produce weekly illustrated papers, based on the *Illustrated London News*, were unsuccessful. Engraving the woodblocks used for the illustrations was time-consuming—a single block might take nearly a week to produce—and thus expensive. The smaller market in Australia relative to Britain meant that this expense could not be recouped on a weekly basis. Once the switch to monthly was made, however, a number of titles were quite successful. In the late 1880s half-tone technology was introduced to Australia, and the cost of producing illustrations plummeted. As a consequence, the weekly newspapers started being more heavily illustrated, and within a decade the monthly illustrated papers ceased to exist.[566]

With the different styles of information, popular science appeared in the different formats of newspaper in various ways. The more magazine style of the illustrated monthlies lent itself to more extended treatments such as overviews of the observatories and biographical notes. The columns of weeklies have already been mentioned, such as Proctor's column in the Australasian prior to his tour. The dailies news reports of lectures, meetings and astronomical contained scientific information, but letters to the editor were another key source.

[566] Dowling, 'The Culture of Newspapers in Australia from the 1880s to the 1920s', 1996.

4.4.2 Astronomy in books and magazines

Throughout most of the nineteenth century the book trade in Australia was dominated by British publishers. This trade to Australia arose from the earliest colonial period, and was extensive throughout. By the end of the nineteenth century widespread education and an increasingly assertive labour movement—both coming to fruition just at the time that linotype technology was lowering the cost of publication—helped to make Australians some of the highest consumers of print medium in the world, even in the face of the late-century depression. At least one British publisher estimated that Australians spent six times per capita on books as Britons,[567] and Melbourne "received more colonial editions than any other port of the British Empire"[568] while several visitors to Australia in the late nineteenth century noted the extent with which newspapers were read throughout the colonies. However beyond newspapers and a few mostly short-lived journals there was little by way of successful local publication until the 1890s, Marcus Clarke's novel 'For the Term of His Natural Life' published by George Robertson in 1874 being very much the exception that proves the rule.

Non-fiction was by no means the major genre in Australia. George Hutchinson, the British publisher referred to in the previous paragraph also noted Australian tastes for fiction. This is confirmed by the catalogues of libraries. The shift of Mechanics' Institute libraries from non-fiction to fiction was noted in § 2.6. Reports of the Public Library in Melbourne show that 55-60 per cent of books lent were works of fiction.[569] However within the non-fiction categories, science ranked as the second most popular to history. A third source to confirm the dominance of fiction in the Australian book market is the journals that arose in the late nineteenth century, around the new literary movement of that time. These journals were also primarily based around fiction and poetry. However, here too, science was a minor but definite component of the non-fiction and astronomy had a visible presence amongst these articles. Some examples are "An Hour with the

[567] 'What Australians Read', *Cobram Courier*, 16 Feb. 1893, p. 6.

[568] Lyons and Arnold, *A History of the Book in Australia, 1891-1945*, 2001.

[569] eg 'The Public Library', *Age*, 27 Oct. 1893, p. 6.

Astronomers" by Thomas Henry in the *Sydney Quarterly Magazine* in 1885 and the "The Occultation of Venus as I Saw it" by Alice Ham in the *Centennial Magazine* in 1888.[570] For these writers, scientific ideas were at least a small part of a progressive Australian literary culture.

There had already been a few attempts to establish popular scientific journals in Australia. One early example was the *Sydney Magazine of Science and Art* established in 1857. Twenty-two issues over two years were produced before folding. Similarly short-lived was the *Australian Mechanic and Journal of science*, published in Melbourne in 1872–73. Both of these titles emphasized technological developments, underlining a colonial interest in practical knowledge.

Following Broks' dictum again, another trace of astronomy found in the literary journals is the rise of science fiction writing in the late nineteenth and early twentieth centuries. The most common form for these early stories was a kind of anthropological romance, such as the works of Guy Boothby, James Hogan and Ernest Favenc, all of which feature variations on the theme of travellers becoming lost in a remote part of Australia and making contact with a previously unknown tribe.[571] The interests here are primarily the experience for Europeans of the Australian landscape and Indigenous presence (although the latter is chiefly notable for the lack of genuine engagement with the actual facts of Indigenous Australia).

There were some examples of astronomical science fiction. Two of the earliest such stories are *Melbourne and Mars* written by Joseph Fraser in 1889, and *The Germ Growers* by Robert Potter in 1892.[572] Potter's book has been described as being "the world's first story of an alien invasion".[573] In both of these works the presence of alien life forms is

[570] Henry, 'An Hour with the Astronomers', *Sydney Quarterly Magazine*, 137–42; Ham, 'The Occultation of Venus as I Saw It', *Centennial Magazine*, Dec. 1888, 316–17.

[571] Blackford and others, *Strange Constellations*, 1999, pp. 3–4, 9–12.

[572] Fraser, *Melbourne and Mars*, 1889; Easterley and Wilbraham, *The Germ Growers*, 1892.

[573] Blackford and others, *Strange Constellations*, 1999, p. 15.

used as a way of interrogating ideas about humanity—in the former case with a utopian vision, the latter with a dystopian one. These works underline the interest in the possibilities of life on other planets, and show how considering these possibilities informs an understanding of the human life on ours. These are thus a direct manifestation of the cultural schema of astronomy as giving insight into the human condition through considering the possibility of life on others.

Another remarkable story is ‘The Social Code’ by journalist and writer Erle Cox, published in *Lone Hand* magazine in 1909. In this story the figure of the astronomer himself plays a central role. Warren Gray is the Australian in charge of the ‘Mt Kosciusko [sic] Stellascope’, a device that allows him to see and communicate with an elderly Martian astronomer. He eventually sees in his telescope—and falls in love with—the Martian’s young assistant. A somewhat risqué story develops (which could be seen as presaging the rise of various twenty-first century webcam services) but the Martians eventually catch the assistant and, frowning on the relationship that has developed, put her to death. In this story the stereotype of the dedicated and somewhat unemotional scientist is invoked and played with and is thus a marker in which the professionalization of science became a public trope. The rise of this stereotype in the late nineteenth century will be discussed further in § 5.4.

Turning attention from broader uses of astronomy to specific astronomical texts, we see that several of these were present in Australian libraries from early days. One example of this is given in the famous *Settlers and Convicts* by An Emigrant Mechanic, in which he describes his newly acquired library as:

> the book on Chemistry already named [A Chemical Catechism, by —— Parkes]; Volney's Ruins of Empires; a number of the Oxford Encyclopaedia, containing “Astronomy;” Hume's Essays; several volumes of Byron's and Scott's works; Sibylline Leaves by Coleridge; a large volume of lectures on Metaphysics by Professor Browne of one of the Scotch universities; Euclid; a number of odd volumes of history by Robertson, Hume and Smollett, and others; and lastly, a quantity of little volumes with and without title-pages,

> among which were a Latin Grammar and a very incomplete Latin Dictionary with the mark of a red-hot poker nearly half through it.[574]

While many details of this supposedly autobiographical tale should be treated with considerable suspicion, this account gives evidence that astronomy was able to be found in colonial libraries at this time.

The catalogues of Mechanics' Institutes provide evidence for which titles were particularly well known in Australia. Table 4.2 shows the most common astronomical holdings of selected Mechanics' Institutes.

There are three features about these works that I will comment upon. The first is the prevalence of natural theology amongst these works. This subject will be explored more fully in Chapter 5 but it is worth noting Topham's argument that the Bridgewater Treatises were valued as much for the "safe science" they contained as for the theological content.[575] This would have been particularly valued by middle-class patrons of Mechanics' Institutes. A second feature is the number of these that are heavily illustrated works including *Gallery of Nature* by Milner. This connection between illustration and astronomy was described in § 4.1; its significance for the history of books will be described later in this section. Here I note that such beautifully illustrated works were seen as suitable subjects for prizes and gifts,[576] again reinforcing the idea of astronomy as a respectable unit of culture. Finally, it is no surprise to suggest that the cultural schemata described through this thesis are strongly evident in these works. Figure 4.10 shows a plate from Nichol's *Architecture of the Heavens* which clearly expresses the cultural schema of astronomy as an exemplary science. Astronomy is here representative of the history of thought. Astronomical observations can be made by everyone and were made by ancient people; astronomy is the way that people learned about science.

[574] Harris, *Settlers and Convicts*, 1847, p. 167.

[575] Topham, 'Science and Popular Education in the 1830s', *The British Journal for the History of Science*, 1992, 397–430.

[576] 'Annual Exhibition: Paddington Public School', *Evening News*, 14 Dec. 1871, p. 2.

British publishers dominated the colonial book trade in general, and for scientific works in particular, but there were locally produced volumes on astronomy. The first such was written by the schoolteacher and historian James Bonwick.[577] Bonwick arrived in Tasmania in 1841 and established a school. Having variable success with that he tried his luck on the Victorian goldfields with even less fortune before founding another unsuccessful school in Melbourne. He had better results as a school inspector, at least until he was forced to give up his post following an accident. Another school eventually failing and another series of government appointments followed before Bonwick returned to London permanently.

Where Bonwick successfully entered Australian history is as a prolific author and one of the countries first systematic historians. His books span a range of subjects, but one set was a group of books for Australian students, including the astronomical work. Bonwick would also give lectures on astronomy, again based around a standard set of slides.[578]

Astronomy for Young Australians was published by Thomas Harwood in Melbourne in 1864.[579] It followed the pattern of a dialogue between adult instructor and child learner, and was based on the experience of seeing the stars change on a voyage between Britain and Australia. This dialogue form was common in the early nineteenth century but was somewhat dated by 1864; *Astronomy for Young Australians* was thus already at the end of its era in both genre and content by the time it appeared. Nonetheless, it remained the only truly popular work in astronomy published in or for Australia until the pamphlets of Proctor's lectures in 1880, although *Astronomy for Beginners* was published in New Zealand in 1874.

By the end of the century these works had been joined by Mary Acworth Orr's 'Southern Stars', published in 1896.[580] Mary Orr would be a significant popularizer of astronomy

[577] Featherstone, 'Bonwick, James (1817–1906)'.

[578] 'Advertising. Lecture on Astronomy', *South Bourke Standard*, 5 Dec. 1862, p. 1.

[579] Bonwick, *Astronomy for Young Australians*, 1864.

[580] Orr, *Southern Stars*, 1896.

both during her time in Australia, and more substantially after her return to England in 1895. Orr wrote her guide as she felt that no suitable work existed. She was encouraged in this by the well-known amateur John Tebbutt, who also wrote a foreword for the book. Figure 4.11 shows the front cover of the book featuring a starry sky including the ubiquitous Southern Cross in the top right hand corner.

None of these early Australian works was heavily visual but as described above, richly illustrated astronomical books were well known in the colonies by this time. Indeed the enduring connection between astronomy and visualization described in § 4.1 is also strongly present in print technologies.

One of the best demonstrations of this that some of the first uses of new printing technologies was to produce illustrated astronomical books. In the late 1830s chromolithography became a practical technology; it would go on to be the dominant form for producing coloured illustrations through the nineteenth century, One of the first books produced by this technique, in 1842, was Blunt's *The Beauty of the Heavens*.[581] Not long afterwards in 1844 was a similar work, *The Heavens Illustrated*. Both works were known in Australia, the former being advertised for sale from 1847[582], and a copy of latter being in the famous amateur astronomer John Tebbutt's library. These books, samples from which are seen in Figure 4.12, are explicitly structured like magic lantern shows with a similar range and style of imagery. They thus doubly show the association of astronomy with visualization.

In the 1870s photomechanical processes for image reproduction were introduced and again an astronomical work would be one of the first produced with the technique—Nasmyth and Carpenter's *The Moon Considered as a Planet, a World and a Satellite* from 1874[583] (Figures 3.2, 3.3). The latter of these was not only a significant work in the history

[581] Blunt, *The Beauty of the Heavens: A Pictorial Display of the Astronomical Phenomena of the Universe*, 1840.

[582] 'Display Advertising', *Courier*, 13 Nov. 1847, p. 3; 'Advertising', *Launceston Examiner*, 22 Jan. 1848, p. 7.

[583] Nasmyth and Carpenter, *The Moon: Considered as a Planet, a World, and a Satellite*, 1874.

of popular astronomy, but was significant in the history of publishing itself, as one of the first books to be produced using the Woodburytype process of mechanical image reproduction. (Darwin's *The Expression of Emotions in Man and Animals*[584] was the first book to be produced with heliotype.) These books were known in Australia not just through the slides brought by Proctor, they were also distributed widely in their own right; Nasmyth's *Moon*, for example, was entered into the State Library of Victoria as early as 1875.[585]

As mentioned in the previous chapter, Nasmyth's images of the Moon's surface were amongst the most detailed and sophisticated visualizations of the late nineteenth century. They were photographed from carefully constructed plaster models, generally around half a metre in size. These models were then lit to recreate the appearance of the Moon seen through telescopes, and photographed (Figure 3.2). The fusion of model-making and photography was not itself unique but these models contained a wealth of experience; Nasmyth had been modelling the Moon's surface for over twenty years before the production of this book. Because of this experience the images were highly praised by scientists such as Herschel, de la Rue, and Lassell;[586] Lockyer said that "no more striking or truthful representations of natural objects have ever been laid before his readers by any student of science".[587]

Nasmyth's book contained not only images of the simulated surface of the Moon, but also other striking images. The photographs of the withered apple and hand of an elderly person were described in § 3.4; another impressive image was a cracked glass sphere (Figure 4.13). These visual analogies were evocative; they were also deliberately intended to be persuasive. Nasmyth's book was a defence of the then-conventional theories about the formation of the Moon: that it had shrunk, upon cooling, which created its mountain ranges, and that craters were of volcanic origin. (Proctor, despite using Nasmyth's images,

584 Darwin, *The Expression of the Emotions in Man and Animals*, 1872.

585 Tsara, 'Enquiry Re Provenance of the Book "The Moon"' (email), pers. comm. , 16 Oct. 2015.

586 Robertson, "Science and Fiction", *Victorian Studies,* 2006.

587 Lockyer, "The Moon", *Nature*, 1874.

was the major public advocate for the newer theory of an impact origin for lunar craters). The visualizations in *The Moon Considered as a Planet, a World and a Satellite* are a notable example of many of the features of popular science that are described in this thesis: the mixed character of its communication to scientific and lay audiences; the persuasive aspects of ostensibly informative discourse; and the expansiveness of the meaning-making of popular science, specifically in exploiting the gap created by visual representations and imagined referents.[588]

[588] Boyle, "You Saw the Whole of the Moon", *Leonardo*, 2013.

Source: Internet Archive

Figure 4.10 Illustration from *Architecture of the Heavens*, 1842

The *Architecture of the Heavens* by John Pringle Nichol was a significant popular work on astronomy. It was held in several Mechanics' Institute and other libraries in colonial Australia. Like many other such works it was lavishly illustrated, an expression of the persistent association between astronomy and visualisation.

This plate from the work illustrates an ancient Jewish shepherd family, as indicated by the star of David, the headwear and the crook. This invokes the cultural schema of astronomy as an exemplary science, with the history of astronomy standing as a metaphor for the history of science itself. The teleological narrative of the text also connects with the schema of astronomy as giving insight into religion.

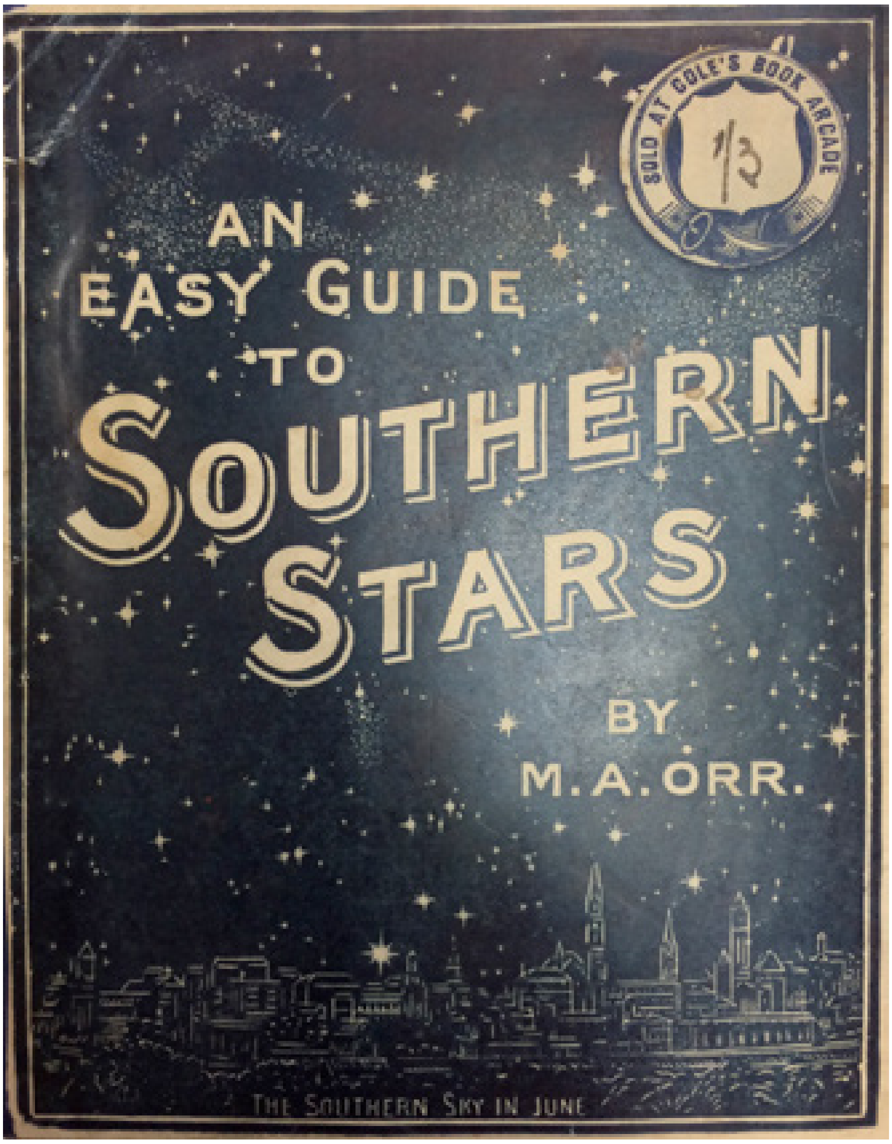
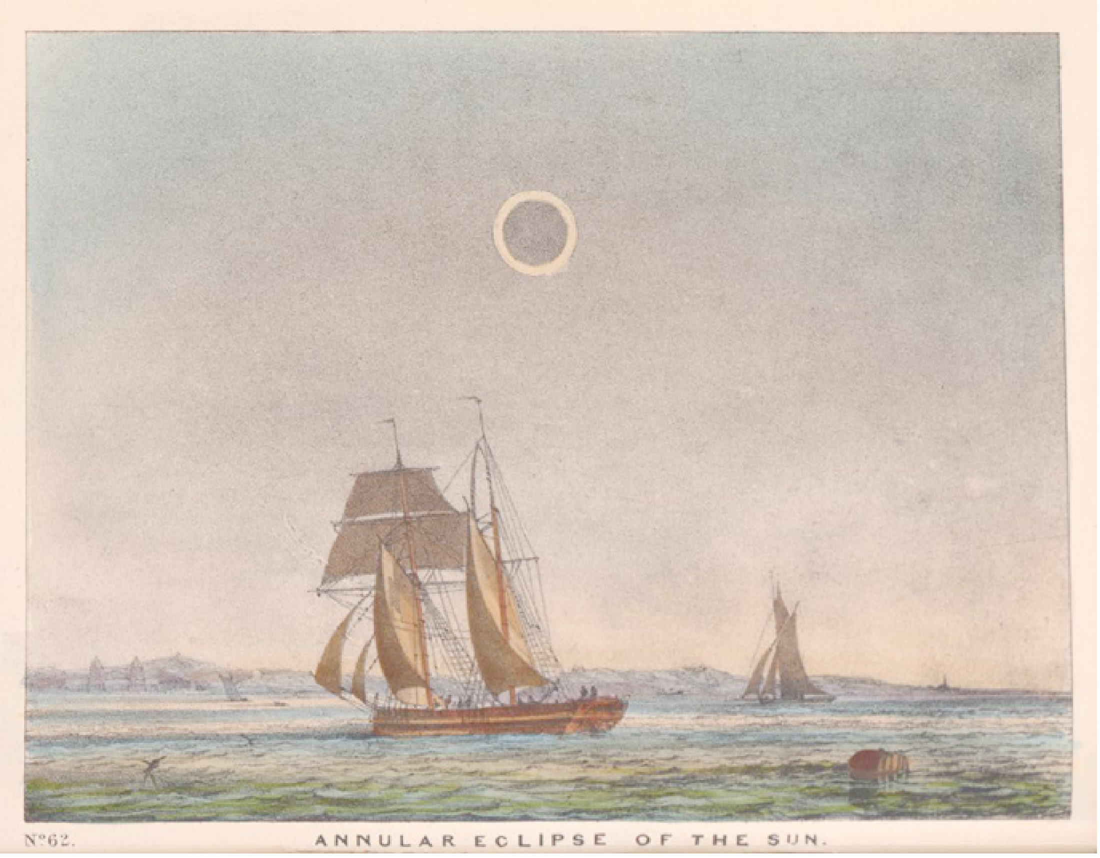


Figure 4.11 **Cover illustration, *An Easy Guide to Southern Stars*, 1896**

Mary Orr was a significant astronomical popularizer of the late nineteenth and early twentieth century. She lived in Australia between 1890 and 1895 and in this time wrote this first locally written (although London published) guide to the southern stars. Mary Orr was encouraged in her production of this guide by the famous Australian amateur astronomer John Tebbutt, who also wrote a foreword for the book.

This image shows a view of the southern stars seen over a skyline of Sydney. The 'principal constellation of the southern hemisphere', the Southern Cross, can be seen in the top right hand corner of the image.

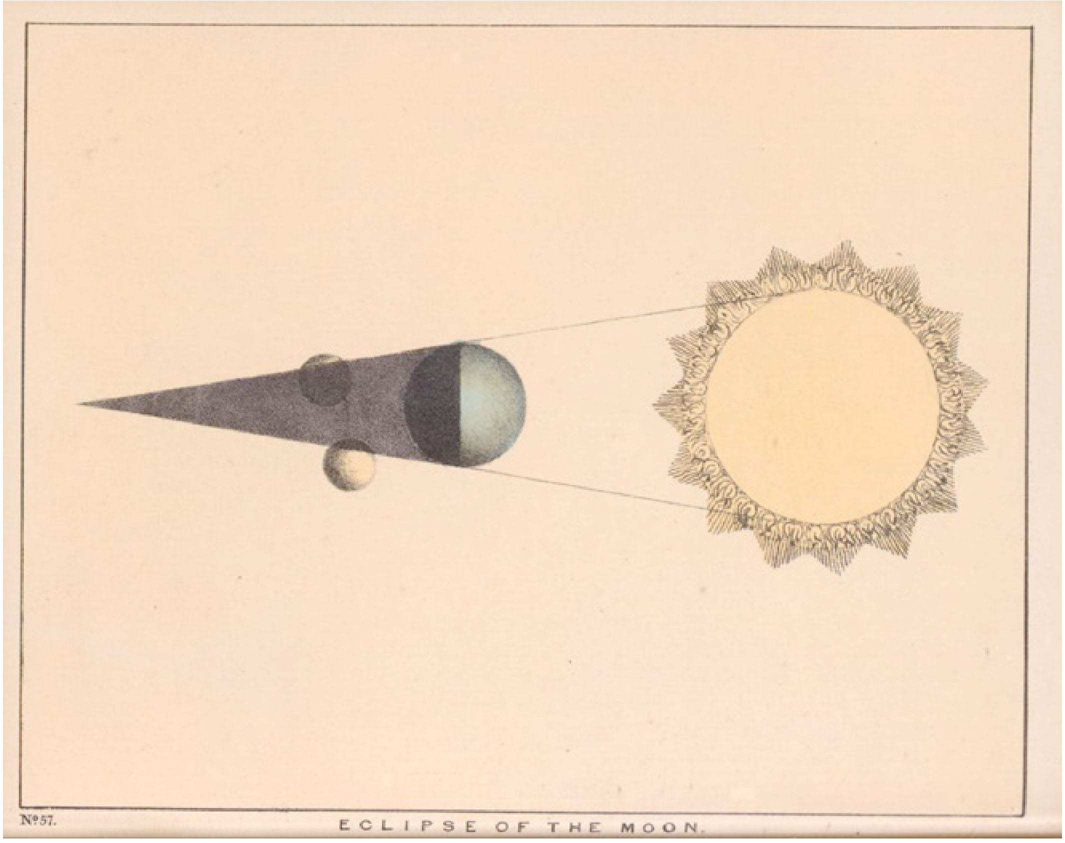


Source: ETH-Bibliothek Zürich

A

Figure 4.12 Blunt's *Beauty of the Heavens*, 1842 and *The Heavens Illustrated*, 1844

Images A (above), B, C (next page) are from the 1842 edition of Charles' Blunt's book *The Beauty of the Heavens*. This book was printed using colour lithography, a technique developed within the previous decade, and is thus a significant indicator in the quality of illustration allowed by developments in printing in the nineteenth century. Images D, E, F (page after next) are from *The Heavens Illustrated*, a similar work from 1844.
Both works reflected the format of an astronomical lecture, showing the cultural power of that medium.



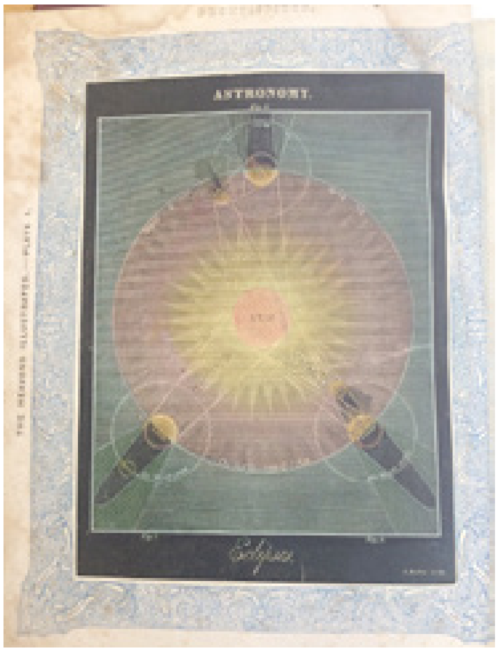
B

C

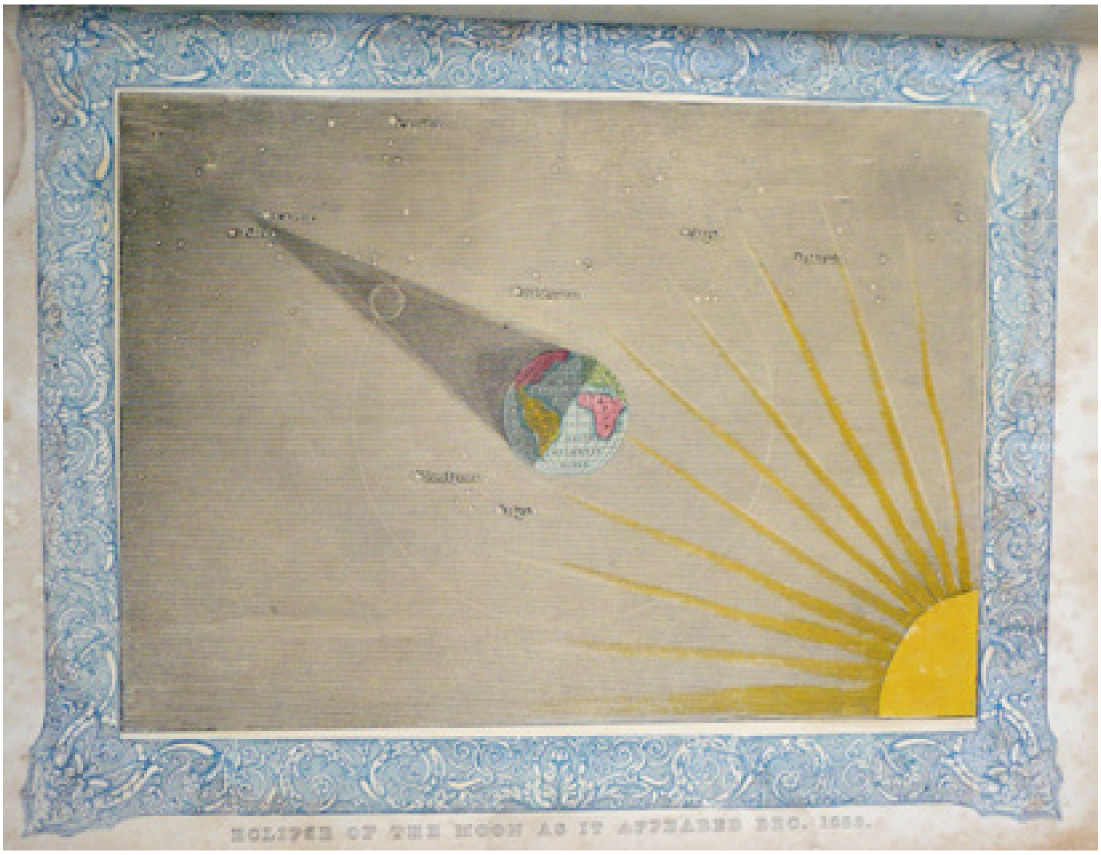
Source: ETH-Bibliothek Zürich

Figure 4.12 **(continued)**

D



E



F

Figure 4.12 **(continued)**

Source: Internet Archive

Figure 4.13 Image from Nasmyth's *The Moon*

This image of a cracked glass sphere from Nasmyth's book *The Moon Considered as a World, a Planet and a Satellite* is an example of the persuasive nature of visual communication. It was intended to show by analogy that cracks on the Moon were formed as the satellite cooled.

Many of the visualizations in this book were intended to persuade the reader of the likelihood of a particular hypothesis about the origin of mountains and craters on the Moon. This persuasive aspect stands in contrast to the self-image presented by many popularizers as being neutral communicators of information. While this rhetorical technique is not confined to popular science, the contrast in this field is especially stark.

Table 4.2 Significant astronomical works held in selected Mechanics' Institute libraries, 1854–64

	Sydney (1864)	Melbourne (1854)	Hobart (1860)	Launceston (1861)	Ballarat (1864)	Bendigo (1860)	Prahran (1858)
Astronomy and General Physics Whewell (1833)	●	●	●	●	●	●	
Outlines of Astronomy Herschel (1849)	●		●		●	●	
Celestial Scenery Dick (1845)			●	●	●		●
The Planetary and Stellar Worlds Mitchell (1848)		●		●			
Orbs of Heaven Mitchell (1851)				●			●
The Solar System Hind (1852)					●	●	
The Gallery of Nature Milner (1846)			●		●		
Popular Lectures on Astronomy Arago (1845)					●	●	
Vestiges of the Natural History of Creation Chambers (1844)					●		●
Architecture of the Heavens Nichols (1837)	●	●					
On the Connexion of the Physical Sciences Somerville (1834)			●		●		
Scientific Dialogues, Vol 2: Astronomy Joyce (1828)				●	●		

4.5 Conclusion

This chapter has detailed the persistence of the association between popular astronomy and visual communication and the technologies through which this association has been manifested. Several of the cultural schemata associated with astronomy were important to this association, especially the schema of astronomy as an exemplary science and its expression through mathematically perfect geometry. The more widespread knowledge practices at the time, such as the Victorian-era belief in 'teaching through the eye' is also evident. In keeping with the notion that 'there are no visual media', this was inherently bound up with material techniques of manufacture and trade, which shaped the distribution of these practices.

A detailed examination of the visual and material practices associated with popular astronomy powerfully reveals how the cultural schemata were enacted. They both reflected and shaped practice, and magnified social relations. Visual formats established particular forms of knowledge-claim, both in terms of bases of authority for those who made the claim, and deeper epistemologies underlying understanding of the scientific; and visual forms of argument enhanced the spread and impact of the science of astronomy.

Of especial interest here is the way that particular forms of visual and material practice took on stable forms, allowing them to spread and be performed more easily and with a greater reach. This was not without cost: the success of the standard astronomical lantern set depended on various commercial and cultural networks which survived for a long time but eventually broke down.

One of the shifts that disrupted these networks was the change in who was considered authoritative in speaking about science, away from the lecturer 'ready to speak on anything at the drop of a hat' and towards the newly professionalizing experts. This change occurred throughout the nineteenth century, but in Australia at least, accelerated towards the end of that century. Visual forms and epistemologies were intimately involved in that shift.

One consequence of this examination of forms of authority is helping to expose just what a strange beast ‘popular science’ is. One of the key features of this practice is that it involves varying and asymmetrical levels of direct interest. We understand that audiences are not passive, and actively transform the knowledge they receive. And yet communicators are often strongly engaged in the subject while audiences are typically addressed as non-expert, and hence less engaged in the subject of the communications. How to understand this asymmetrical participation in content is a significant puzzle for the analysis of popular science. The framework that I have adopted of cultural schemata can help to make sense of this, by revealing how the specific forms of popular astronomy become associated with cultural concerns of deep interest to the audiences.

Another aspect of this asymmetry is that popularizers are often highly motivated to persuade their audiences. One example of this is the use of popular astronomy by the freethought movement in the late nineteenth century. This case study, and other persuasive uses of popular astronomy, will be the subjects of the next chapter.

5: Uses of Popular Astronomy:

Secular, labour and professional politics

This chapter focuses on the rhetorical uses of popular astronomy. It does so in order to highlight the persuasive aspects of popularization. Previous studies of popular science have drawn out many different motivations for its practitioners, including the commercial and the sublime described by Huang, scientific mobilisations, as described by Bigg, professional status as described by Turner and others, or social identity.[589] This chapter will concentrate on the role of popularization in persuading others in other contexts.

The category of persuasive communication is to a large extent an analytical invention. As has been extensively documented, scientific discourse is inherently persuasive in nature, and uses of popular astronomy, such as the examples provided by Karnfelt describing how astronomers used popular communications to signal their ideas about the subject of 'island universes' to their colleagues,[590] are surely equally so. Purely commercial uses of popularization are also aimed at motivating the audience to return, or recommend the show to others. Few theorists of communication today would accept a typology of communicative acts as informative, persuasive or entertaining as truly adequate.

---

[589] Huang, 'Commercial and Sublime', PhD thesis, 2015; Bigg, 'Staging the Heavens: Astrophysics and Popular Astronomy in the Late Nineteenth Century', 2010, pp. 304–24; Turner, 'Public Science in Britain, 1880-1919', *Isis*, 1980, 589–608.

[590] Karnfelt, 'The Popularization of Astronomy in Early Twentieth-Century Sweden: Aims and Motives', 2009, pp. 175–94.

Nonetheless, considering the persuasive aspects of popular science has considerable merit as a heuristic device. One reason in particular is because of the contrast between the self-image of the popularizers and their actual practice. Both Proctor and Pepper, for example, emphasized the didactic aspects of their performance, and they were hardly alone. Pepper averred that his purpose was “the cause of making the truths of science known to the public”;[591] Proctor, as described in § 3.4, suggested that “it does not befit the lecturer on so noble a subject to intrude his petty personality between that subject and his audience”.[592] Yet the performances of these two, or those of other popularizers, cannot properly be understood through that lens; the public cultures of thought, literature, politics and entertainment all impacted on their reception. Nor was this just a matter of a background context being important—both of these popularizers deliberately involved themselves in religious questions, for example, as a means of promoting science. Both were motivated by financial concerns. Both were also highly protective of their personal reputations. They had additional motivations. Pepper was interested in attacking spiritualism, Proctor, in promoting a particular ideal of the entrepreneurial scientist.

Popular science thus often involves a rhetorical move wherein the lecturer claims to be disinterested, yet their practice shows otherwise. Examining the persuasive aspects of the communication is thus revealing about the action of popularization beyond the descriptions given by the popularizers themselves. In particular, a focus on the deliberate ways in which the cultural schemata of popular astronomy were deployed will help to reveal those schemata as consciously perceived resources.

This chapter will undertake this examination through a return to specific case studies of popularization. Previous chapters of this thesis have examined both contexts and case studies. Chapter 3 concentrated on the latter, in the form of the activities in Australia around 1880 of the most sophisticated professional astronomical popularizers, Richard Proctor and Professor Pepper, while Chapters 2 and 4 considered the contexts of popular practices and technological formats respectively. The case studies for astronomical popularization here will be its use in radical politics and professional organization.

591 ‘Professor Pepper’, *Argus*, 12 Jul. 1879, p. 8.

592 Proctor, ‘Mr Proctor’s Farewell’, *Argus*, Jan. 1881, p. 7.

5.1 Popular astronomy in secular–religious disputes

Popular astronomy was invoked regularly in the debates that occurred in the late nineteenth century over the social and intellectual role of religion. Both freethinkers and defenders of orthodoxy alike pointed to the stars as support for their respective positions. That similar facts, in lectures using similar technology, could be used to serve radically different ends in itself shows clearly that the importance of astronomy was as much about the complex connotations that were adduced—that is to say the cultural schemata—than about a narrow interpretation of the content.

The first two sections of this chapter will examine the religious–secular dialogue of the late nineteenth century, and the role of astronomy. The first section will consider the broader context, while the second examines the public disputation between the freethought movement in Australia and New Zealand and its religious opponents. This proves to be a revealing case study, not least because the echoes of it remain to be heard in popular discourse ever since. However it is the sharp edge rather than the whole; I emphasize that this conflict does not represent the totality of this dialogue at the time. Even amongst radical politics, the freethought movement was just a small part, while religious opinion similarly varied from liberal to conservative. This broader political context will be examined in § 5.3.

5.1.1 The Darwinian context

Astronomy was not the only science involved in such debates. By far the most significant context for cultural debate about science in the second half of the nineteenth century was Charles Darwin's theory of evolution by natural selection. The *Origin of Species by Natural Selection* was published in London in 1859. The *Origin of Species* was on sale in Sydney just four months later;[593] Darwinism became a major topic of discussion almost as quickly in Australia as it did in Britain.

Within four years there had been significant public controversies in the colonies regarding the subject. In 1863 the new Professor of Anatomy at the University of Melbourne, and anti-Darwinian, George Halford, gave a series of public lectures that challenged the opinions of Thomas Huxley regarding primate anatomy and thus, by extension, the whole theory of evolution by natural selection.[594] These lectures provoked quite a reaction: the episodes that followed include the public display of a dissected monkey, the two major Melbourne newspapers the *Age* and the *Argus* entering the fray taking anti- and pro-Darwinian positions respectively, Huxley himself having a response to Halford printed in the Argus, and Halford chasing fellow doctor William Thomson out into the street with a scalpel.[595] Halford had been supported in this dispute by fellow University Professor, and Director of the National Museum, Frederick McCoy, who provoked a further round of public disputation in 1865 when he obtained the body of a gorilla and displayed it in the Museum to show "how infinitely remote this creature is

[593] Butcher, 'Darwinism Down Under: Science, Religion and Evolution in Australia', 2001, pp. 39–60.

[594] 'Man's Place in Nature', *Age*, 17 Jul. 1863; 'The Relations of Man to the Lower Animals', *Age*, 1 Aug. 1863.

[595] 'University of Melbourne', *Argus*, 23 Sep. 1863; 'Melbourne, Saturday, 18th July, 1863', *Age*, 18 Jul. 1863; '(No Title)', *Argus*, 20 Jul. 1863; 'Professors Huxley and Halford', *Argus*, 4 Feb. 1864; Thomson, 'Two-Handed or Two-Footed?', *Argus*, 22 Jul. 1863.

from humanity".[596] This incident is detailed by Butcher in *Australian Science in the Making*.[597]

Halford and McCoy were not the only significant opponents of Darwinism in Australia. Other scientific critics included Macleay, in Sydney, while social support for the opposition to evolutionary theory came from colonial governors, like Henry Barkly (also a former President of the Royal Society of Victoria) and William Denison, as well as religious leaders like the Archbishop of Melbourne, Charles Perry. Ranged against them in support of evolution include scientific Darwinists such as the 'father of Australian science' William Branwhite Clarke and, after about 1870, Gerard Krefft at the Australian Museum. Other, less prominent scientific workers also adopted Darwinian approaches, such as the surveyor and orchidist Robert Fitzgerald. As in other parts of the world, scientists increasingly embraced the theory of evolution by natural selection, and by the 1870s McCoy's continued rejection of Darwin was looking old-fashioned to his students.[598]

The Darwinist theory engendered public controversy because it suggested a materialistic understanding for the origins of humans. This was interpreted by many as opposing scientific accounts to those of the Bible, undermining the veracity of the latter and thus of religious authority. In particular, this challenged the tradition that had interpreted scientific theories as supporting religious content—natural theology.

[596] 'Gorillas at the National Museum', *Argus*, 20 Jun. 1865.

[597] Butcher, 'Gorilla Warfare in Melbourne: Halford, Huxley and "Man"s Place in Nature'', 1990, pp. 153–69.

[598] Butcher, 'Darwinism and Australia', PhD thesis, 1992, p. 103.

5.1.2 The natural theology context

The natural theology tradition—or traditions—attempted to develop a relationship between religion and natural philosophy. These ideas were particularly influential in Britain, although not exclusive to it. Ideas about the organization of nature showing attributes of a Creator are ancient. However the rise of Newtonianism, and the suggestion that mechanistic explanations may explain the operations of nature threw a different light on this problem: why would an all-powerful god organize the Universe so that it operates apparently without divine intervention? [599] These ideas developed over the course of the eighteenth century. The fullest expressions of the tradition are widely considered to be Paley's book in 1802[600] and the Bridgewater Treatises of the 1830s, although Brooke and Gillespie both point to the diversity within the broad framework of natural theology.[601]

Paley's book downplayed the role of astronomy in natural theology. He thought "that it is not the best medium through which to prove the agency of an intelligent Creator".[602] Instead, Paley preferred to use the evidences from natural history of the purported design of living creatures, with the eye famously his prime example. In this he followed the earlier opinion of Robert Boyle, who was also concerned about the suitability of astronomy as a field of theological instruction.[603] Although certainly magnificent, the planets and stars seemed too remote from human experience to be able to provide a convincing demonstration in terms of purpose.

[599] Gillespie, 'Natural History, Natural Theology, and Social Order', *Journal of the History of Biology*, 1987, 1–49.

[600] Paley, *Natural Theology*, 1802.

[601] Brooke, 'Natural Theology and the Plurality of Worlds', *Annals of Science*, 1977, 221; Gillespie, 'Natural History, Natural Theology, and Social Order', *Journal of the History of Biology*, 1987, 1–49.

[602] Paley, *Natural Theology*, 1802, p. 247.

[603] Gillespie, 'Natural History, Natural Theology, and Social Order', *Journal of the History of Biology*, 1987, 1–49.

Despite the concerns of Boyle and Paley, astronomy played a prominent role within the natural theology tradition. That "the heavens declare the glory of God" was a sentiment from Psalms taken up enthusiastically. Two examples from Britain are the works of the Rev W Hutton, and William Kirby's Bridgewater Treatise on animal behaviour. In Australia, Oxford theologian Henry Scott Holland's affirmation of astronomy's importance to natural theology was being reported as late as 1895, while a correspondent to the *Ballarat Courier* earlier declared the psalm to find "a response in every human heart, and which mankind will continue to cherish as an eternal truth".[604] The immanence of astronomical observations to people's lives, and the emotional power of the sublime, combined with the availability of the ready-made lantern slide sets described in the previous chapter combined to make astronomy a favourite subject for religiously motivated lecturers throughout the nineteenth century. As remarked throughout this thesis, the cultural schema of astronomy as giving insight into religion was strong.

In contrast to Paley's work, the *Bridgewater Treatises* celebrated the role of astronomy in demonstrating the truths of natural theology. Astronomy was the subject of one complete volume, by William Whewell.[605] This work did not meet with uniform approbation: Whewell's erstwhile associate Charles Babbage was so appalled by his arguments in favour of natural religion that he penned his own, 'Ninth' Bridgewater Treatise to establish what he thought to be a more reliable argument in favour of the consistency of science with religion.[606]

These differing views about the relation of science to religion draw our attention to other complexities. Lightman reminds us not to over-simplify matters by treating scientific naturalists as either monolithic or culturally dominant: "They were one group among

[604] Hutton, *The Book of Nature Laid Open*, 1821, p. 209; Kirby, *On the Power, Wisdom and Goodness of God*, 1835, p. 522; 'Religious', *Queenslander*, 16 Mar. 1895, p. 493; 'Scientific', *Ballarat Courier*, 18 Aug. 1874, p. 3.

[605] Whewell, *Astronomy and General Physics Considered with Reference to Natural Theology*, 1833.

[606] Babbage, *Passages from the Life of a Philosopher*, 1864; Babbage, *The Ninth Bridgewater Treatise: A Fragment*, 1838.

many that vied for cultural authority during this period by drawing on the immense prestige provided by science".[607] Throughout the nineteenth century, difference of opinion about religion interacted with different ideas about the organization of science, as the professionalising scientists sought to diminish the authority of the amateur, of which the clergy were a large component.

One such complex relationship, and another arena of secular–religious tension was the plurality of worlds debate described in §3.3.1. By the nineteenth century, the position of conservative, if not orthodox, Christians had become increasingly settled on the matter: divine Revelation and the singularity of Christ meant that there could be no life on other worlds. The plurality of worlds doctrine thus served as yet another proxy in the debates about the mutual relations of science and religion, with both those who suspected they were antagonistic and those who believed them to be compatible adopting particular viewpoints.[608] These attitudes were intimately bound up with fundamental opinions of theology, and thus varieties of natural theology.[609] Public discussion of the question in Australia was more guarded, and rarely invoked these theological viewpoints explicitly.[610] Scholarship has generally regarded the natural theology tradition in Australia as "almost entirely derivative" and reflecting "what was happening in Britain".[611]

It has been noted that many of the astronomical lecturers in Australia were clergy. It is particularly notable that several of these were especially active in the years immediately following the publication of the *Origin*, including James Adam and Thomas Hayden.[612] This book was perceived nearly immediately as a major disruption in perceptions of the

[607] Lightman, 'Victorian Sciences and Religions', *Osiris*, 2001, 343–66.

[608] Crowe, *The Extraterrestrial Life Debate, 1750-1900*, 1999; Crowe, 'Astronomy and Religion (1780-1915)', *Osiris*, 2001, 209–26.

[609] Brooke, 'Natural Theology and the Plurality of Worlds', *Annals of Science*, 1977, 221.

[610] 'Other Worlds', *West Gippsland Gazette*, 7 Nov. 1899, p. 3.

[611] Phillips, 'The Defence of Christian Belief in Australia 1875–1914', *Journal of Religious History*, 1977, 402–423.

[612] 'Astronomical Lectures', *Bathurst Free Press and Mining Journal*, 3 Jul. 1861, p. 4; 'Advertising', *Sydney Morning Herald*, 18 Nov. 1862, p. 1.

relationship between science and religion. This disquiet would grow over the next few decades until the freethought movement emerged in the 1880s to openly challenge the status of religion in society.

5.2 Secularism in Australia and New Zealand: Joseph Symes and William Whitehouse Collins

The precise level of traction that this conflict had in public life in the colonies is difficult to determine precisely. The broader historical question of the level of religiosity of Australian society in the later part of the nineteenth century is a contested one.[613] Histories such as Ward's and Clark's[614] generally subscribed to the view of Australia as "about the most godless place under Heaven".[615] More recent interpretations, such as Macintyre's have been more nuanced.[616] Certainly the lack of an established church was one of the features of the Australian settlement as compared with Britain. There were a number of significant consequences of this. Probably the most significant was the development of the education system, free, compulsory and secular, provided by the state. On the other hand, another consequence was government support for church building for many denominations, leading to a multiplicity of churches in even small towns and prompting Trollope's observation that Australians "are fond of building churches".[617]

Clearly organized religion maintained a strong presence in the cultural life of Australia and New Zealand in the late nineteenth century, regardless of the private beliefs of the population at large. The social impact of the Sabbatarian movement was described in Chapter 3, as one example. In any case it is not necessary to definitively resolve this matter; for the purposes of this thesis it is sufficient to accept the continued, conservative,

---

613 Bellanta, 'A Hard Culture?', *Australian Journal of Politics & History*, 2010, 55–65.

614 Ward, *The Australian Legend*, 1978; Clark, *A Short History of Australia*, 2006.

615 Denney and others, *Letters of Principal James Denney to W. Robertson Nicoll, 1893-1917*, 2015, p. 87.

616 Macintyre, *A Concise History of Australia*, 2009.

617 Trollope, *Australia and New Zealand*, 1873, p. 218.

presence in public life of Christianity. This presence is demonstrated by the response to Joseph Symes.[618]

5.2.1 Joseph Symes

Joseph Symes arrived in Melbourne in February 1884 on a twelve month contract with the Australasian Secular Association.[619] He would remain in the colony until 1906 when he returned to England intending to visit but then died. One of a number of freethinkers who originally trained for the ministry, Symes went further and served as a Wesleyan minister for seven years, before resigning in 1874. He took on a position as a Mechanics' Institute lecturer before joining the National Secular Society in 1876.[620]

Symes introduced a number of notable features to freethought in Melbourne. Most significantly, science in general and astronomy in particular were central to Symes' identity as a freethinker, and his freethought practice. Taking up the study of astronomy is one of the two reasons Symes cited for his move away from Christianity, along with the horrors of the Franco-Prussian War. Symes gave science classes on a weekly basis through 1884, but was forced to give them up due to lack of suitable equipment. However he continued to write about astronomy in the *Liberator*, the newspaper he started shortly after arriving, and to present astronomy to children in the Association's Lyceum, yet another of his innovations.

Symes' articulated a unique form of astronomical argumentation through his repeated claim that there was "much to complain of"[621] in the organization of the solar system.

[618] Smith, 'Symes, Joseph (1841–1906)'.

[619] Andrade, 'Freethought in Melbourne', *The Freethought Review*, 1 Apr. 1884, 8.

[620] Smith, 'Joseph Symes and the Australasian Secular Association', *Labour History*, 1963, 26–47.

[621] Symes, 'The Solar System and Its Boasted Perfections', *Liberator*, 25 Apr. 1885, p. 341.

Most proponents—for or against natural theology—were prepared to accept the grandeur of astronomy. Symes, unusually, denied the “supposed perfections” of the solar system. “I have very little admiration for it” he would write, “Its perfections are mostly moonshine”.[622] This argument was presumably intended to undermine the very foundation of natural theology: anyone who sees design in the solar system “must admit that it is design executed without wisdom and in a very clumsy manner”.[623]

5.2.2 William Whitehouse Collins

Astronomy was deployed even more deliberately by William Whitehouse Collins.[624] Unlike Symes, Collins converted to freethought before taking up the study of astronomy. Collins was born in Staffordshire in 1854, from a politically radical tradition—his grandfather had been a Chartist leader jailed during the ‘Bull Ring’ Riots of 1840 for helping to print placards condemning the police actions.[625] He also trained for the ministry—Baptist—before moving away from religion. The Bradlaugh case, where secularist Charles Bradlaugh was repeatedly refused a seat in the House of Commons only to be re-elected at the subsequent by-election, saw Collins throw his energies into secularism. Subsequently he undertook the Special Diploma offered by the National Secular Society.[626] This formal course had three components: theology, general literature, and science: in particular astronomy, geology, evolution and sociology.[627]

Freethinkers were interested in these sciences in particular because of how they were thought to contradict the accounts of scripture. Astronomy and geology established a timescale that clearly lay in the millions of years at least. Evolution told a story of the

[622] Symes, ‘The Solar System and Its Boasted Perfections’, *Liberator*, 11 Apr. 1885, p. 312.

[623] Symes, ‘The Solar System and Its Boasted Perfections’, *Liberator*, 25 Apr. 1885, p. 341.

[624] Stenhouse, ‘Collins, William Whitehouse’, 2013.

[625] Roberts, *The Chartist Prisoners*, 2008, p. 60.

[626] Andrade, ‘Our Illustration’, *Liberator*, 10 Jan. 1886, p. 102.

[627] Royle, *Radicals, Secularists, and Republicans*, 1980, pp. 151–52.

origins of humans that could not be reconciled with the Genesis narrative. However each of these sciences was involved in the public debate in a slightly different way.

Prior to the *Origin of the Species*, natural history was a mainstay of natural theology; as discussed in § 5.1.2 it was regarded by writers such as Paley as an exemplar. With Darwin's publication, natural history became a major point of contention almost overnight.

However evolution was not the first of the sciences to dispute a literal interpretation of the Bible. By the mid-nineteenth century scientific understandings of geology had already established a history for the Earth that differed from the words of Genesis. However this process happened much more slowly than the announcement of natural selection. It was over the course of a generation, in the early nineteenth century that Biblical Chronology and Noachian theories were abandoned by specialists.[628] It should be noted that most Christian thinkers adjusted their interpretations accordingly and most practicing scientists remained devout. However not all Christians accommodated the longer timescale—a popular geology tradition continued to embrace the older frameworks.

The scientific findings of astronomy were even slower to affect public debate. For all of the progress in nineteenth century astronomy—the nebular theories, variable stars, discoveries in the solar system and refinements in orbital techniques, spectroscopic discoveries – the astronomical facts invoked in science/religion debates of the 1890s had barely changed since the 1810s. These primarily—almost entirely—concerned the plurality of worlds debate, discussed earlier, and the distances to the stars.

William Herschel, as early as 1802, published estimates of stellar distances that implied an age for the Universe of millions of years.[629] For various reasons, astronomers throughout the 19th century shied away from this claim, at least in public. Most significantly,

[628] Rudwick, *The Great Devonian Controversy*, 1985, pp. 42–43.

[629] Herschel, 'Catalogue of 500 New Nebulae', *Philosophical Transactions of the Royal Society of London*, 1802, 477–528.

Herschel's own discovery of binary stars of very unequal brightness destroyed any confidence in his techniques for estimating distances, which relied on all stars being of similar brightness, but there was probably also a reluctance to embrace probabilistic reasoning into a science that had long prided itself on being exact. Other astronomers may have merely wished to avoid controversy. In any case, even Herschel's son John, in his *Treatise on Astronomy* would only claim that "among the countless multitude of such stars, visible in telescopes, there must be many whose light has taken at least a thousand years to reach us".[630] This formulation of stars being 'thousands' of light years away would become the standard one throughout the nineteenth century, repeated in Australian newspapers,[631] although there were some, like Dr Scoresby who would continue to talk in millions of years.[632] In the context of Biblical chronology, the difference between a claim of thousands of years, and millions of years is rather significant. Even Richard Proctor, who would proudly describe timeframes of thousands of millions of years, would deflect the role of astronomy in setting this timescale for Earth, claiming that, in considering the ages of planets, astronomers "have to be beholden to the geologist for such data as enable them to arrive at any satisfactory theory".[633] However this ongoing reticence of astronomers is explained, it meant that public discussion of these matters was derived from astronomical ideas by loose association more than from tight chains of evidentiary reasoning, that is through the operation of cultural schemata.

Nonetheless, for those who looked, astronomy did supply thoughts of deep time, and for many others, the suspicion remained that astronomy described a universe larger, older, and possibly more inhabited than that described by the Bible. Accordingly the association between astronomy and freethought was strong. It is barely a coincidence that one of New Zealand's most prominent evolutionary polemicists, Bickerton, was also noted for

[630] Herschel, *A Treatise on Astronomy*, 1833.

[631] 'The Stars and the Earth', *Adelaide Observer*, 10 Apr. 1847; 'The Stars and the Earth', *Sydney Morning Herald*, 14 Feb. 1860.

[632] *Annual of Scientific Discovery*, 1856, p. 383.

[633] Proctor, *Life and Death of a World*, 1880, p. 4.

his astronomical interests, namely his unconventional theory of stellar collisions.[634] Even though these ideas were formally unrelated to each other, they proved to be concordant: for those persuaded by evolutionary histories and the deep time of geology, like Richard Proctor, it was an easy step to see these processes in the workings of astronomy.

This concordance was also manifest in the work of Collins throughout his time in Australia and New Zealand. Collins arrived in Australia in December 1885. He gave his first lectures in Adelaide, then proceeded to Melbourne, where he relieved Joseph Symes for a few weeks, and Sydney, to take up a three year contract as lecturer to the Sydney branch of the Australasian Secular association.[635] By January 1886, Collins was contributing articles to Symes' *Liberator* that invoked astronomy, and in April 1886 he founded his own newspaper in Sydney, the *Freethinker*, in which astronomical themes would also feature regularly.[636]

Collins' arguments against natural theology were more straightforward, and more familiar than Symes'. He directly advocated what was to become known as 'the conflict thesis' of the relationship between science and religion: the idea that the two fields of intellectual endeavour are inherently opposed to each other, and that throughout history religion has held back science such that progress in the latter can only be achieved with a decline in the former. This idea was most prominently associated with, and named for the work of Draper, and later White.[637] Like these authors, Collins reserved most of his polemics for the Catholic Church. In one of his many pamphlets he would describe a "conflict waged with bigoted and relentless ferocity on one hand, with calm courage, steadfast endeavour and undaunted heroism on the other".[638]

[634] Bickerton, *Romance of the Earth*, 1898; Bickerton, *The Evidence and Scope of the Theory of Impact*, 1905; Bickerton, *The Birth of Worlds and Systems*, 1911.

[635] 'South Australia', *Australian Town and Country Journal*, 19 Dec. 1885.

[636] Collins, 'Biblical Chronology', *Liberator*, 17 Jan. 1886, p. 119; X., 'At the Standard', *Freethinker*, 5 Sep. 1886.

[637] Draper, *History of the Conflict Between Religion and Science*, 1874; White, *A History of the Warfare of Science with Theology in Christendom*, 1896.

[638] Collins, *The Church of Rome: The Enemy of Science and the Foe of Progress*, 1889.

One way that Collins' expressed his version of the conflict thesis, in form as well as content, was in his many debates with clergy. Collins was experienced in such debates already before reaching Australia. In Sydney most mainstream religious leaders refused to debate Collins, although one exception was the Presbyterian Reverend Dr George Sutherland.[639] The recently formed Sydney branch of the Christian Evidence Society also had no such compunction and provided their lecturer J F Floyd for a debate.[640] Similarly Collins met on the platform with other less conventional Christians such as the American spiritualist George Chainey and the freethinker-turned-christian-lecturer Isaac Selby.[641] After his move to New Zealand in 1890 he would continue to challenge clergy to debates. Although the Anglican Archbishop of Christchurch, Julius would continue the policy of refusing to meet Collins, other clergy took up the challenge, notably the United Free Methodist Reverend John Hosking in 1892.[642] Nor was Collins the only freethinker to pursue the strategy of seeking debates: other antipodeans who did so included Charles Bright, Thomas Walker and Isaac Selby (before he renounced freethought).[643]

At the time of the Collins-Hosking debate, the Methodist minister was less experienced in such encounters. However he would go on to use debate as a technique himself. In 1895, for example, he participated in a debate with Woodville resident James Taylor on the subject "Infidelity, is it reasonable?".[644] Indeed Hosking had a reputation as "something of a controversialist".[645] Even before he arrived in New Zealand, he had some notoriety: at Fitzroy, while trying to persuade a tenant to vacate the church's schoolroom, he was accused of emptying "a quantity of offensive matter on the floor".[646] In New Zealand he

[639] '(No Title)', *Sydney Morning Herald*, 16 Apr. 1889, p. 7.

[640] '(No Title)', *Sydney Morning Herald*, 19 Nov. 1889, p. 7.

[641] 'News of the Day', *Sydney Morning Herald*, 20 Aug. 1886, p. 7; Picton, 'Review of the Selby v Collins Debate', *Protestant Standard*, 11 May 1889, p. 7.

[642] *A Theological Debate*, 1892.

[643] Lineham, 'Christian Reaction to Freethought and Rationalism in New Zealand', *The Journal of Religious History*, 1988, 236–250.

[644] 'Debate', *Woodville Examiner*, 18 Feb. 1895, p. 2.

[645] Phillips, 'Independent Methodism in New Zealand'.

[646] 'Charge of Creating a Nuisance', *Argus*, 23 Aug. 1887, p. 5.

was active in the formation of a united Methodist Church in 1896 from the several existing Methodist and Wesleyan churches, but would soon split. Desiring to stand for parliament in 1899, he was expected to resign from the Methodist ministry, but after his unsuccessful candidature he started a new Methodist church "in opposition to the united body".[647] He later returned to Australia to a number of ministries and added further to his public reputation when he advertised for a wife.[648] He died in Broken Hill in 1919.[649]

The very process of creating a public debate, such as with Collins and Hosking, gave life to the idea of two opposing sides with no middle ground. The debate between these two men was particularly pointed because Hosking was also interested in astronomy, in his case from the natural theology tradition. Through 1892 and 1893 Hosking gave several lectures in the Canterbury region on "Astronomy, or the wonders of the Heavens" and "The Science of Religion and the Religion of Science" to demonstrate the presence of a Creator. At this time, Collins was lecturing on topics such as "The Story of the Heavens", "A Trip to the Moon", and "Astronomy, Mythology and Theology". Collins' lectures presented a wholly naturalistic picture; in his Elementary Astronomy lecture he gave special prominence to Newton "whose investigations once and for all shut out the notion of the miraculous as applied to astronomy and showed that everything was amenable to law".[650] On 18 June 1893, both men would deliver astronomy lectures simultaneously, less than a kilometre apart.[651] (See Figure 5.1) Unsurprisingly, in the light of the discussions of the last chapter—lanterns were a major feature of Collins' lecturing; his slides were described as "the best of the kind ever seen in Dunedin".[652]

Collins mobilised the cultural resources of popular astronomy in an attempt to persuade his audiences that science demonstrated the backwardness of religion, to serve the

[647] 'Dr. Hosking and the Wesleyans', *New Zealand Herald*, 28 Feb. 1900, p. 6.

[648] '"Wife Wanted." Rev. John Hosking Advertises', *Truth*, 9 Mar. 1919, p. 9.

[649] 'Dr. Hosking and the Wesleyans', *New Zealand Herald*, 28 Feb. 1900, p. 6.

[650] 'Lecture by Mr Collins', *Evening Star*, 17 Aug. 1893, p. 2.

[651] 'Lectures', *Press*, 17 Jun. 1893, p. 1.

[652] 'Lecture by Mr Collins', *Evening Star*, 17 Aug. 1893, p. 2.

'conflict thesis'. Historical criticism of this product of the late nineteenth century arose early and it is no longer considered accurate or productive as a theory of history;[653] according to Numbers the idea is "historically bankrupt".[654] Throughout history scientists have been more often motivated by theological than by anti-theological concerns, and that a focus on the ideological dimension of religion obscures the other factors—class and institutional—that lay behind many of the nineteenth-century disputes between clerics and scientists.[655]

Yet the conflict thesis has remained as a powerful cultural schema, deliberately invoked by popularizers at the time, and continuously ever since. Despite the fact that many Christians had modified their understanding of the status of literal description in the Bible even before this time, the conflict thesis was able to guide thinking about complex and important subjects in a simple manner. Arguably this compression of meaning is one of the features of successful cultural schemata: while schemata expansively capture experience from a broad domain of culture, as described in § 3.2.4 they allow interpretation of complex knowledge by being easy to recall and conceptualise, and thus simplifying thought.

Certainly the conflict thesis has been successful, outliving by a considerable margin the freethought movement that promoted it. (There have been various rationalist associations in Australia and New Zealand in the period since Collins, but not continuity at an organizational level.) By the 1890s organized freethought was in decline throughout the Australasian colonies for a range of different but related reasons. Lineham expresses the common opinion that "Freethinkers always found it easier to agree on what they opposed than on what they stood for".[656] The Dunedin Freethought Association, for a while one of the most active freethought organizations was devastated on the one hand by an

653 Brooke, *Science and Religion: Some Historical Perspectives*, 1991.

654 Numbers, 'Science and Religion', *Osiris*, 1985, 59–80.

655 Russell, 'The Conflict of Science and Religion', 2002, pp. 3–12 (pp. 7–9).

656 Lineham, 'Freethinkers in 19th Century New Zealand', *New Zealand Journal of History*, 1985, 61–81.

irreconcilable split between the committed atheists and the non-Christian—but avowedly religious—Spiritualists and on the other by the loss of the considerable talents of its long time President Robert Stout to the larger political stage. Stout would go on to be Premier of New Zealand in 1884. Similarly the Sydney branch of the Australasian Secular Association (ASA) was already splintering between spiritualist and atheist factions before Collins arrival; after his departure it disintegrated.

The Melbourne branch of the ASA, once again, was even more dramatic. It split over a combination of political differences and personality. Symes was in many respects politically radical, but he was also avowedly a liberal and never a socialist. Others in the ASA, such as the Andrade brothers, were attracted by both socialism and anarchism. This anarchist faction also grew weary of his increasingly autocratic leadership, and the intemperate way he spoke in public. Both of these developments were possibly brought on by the incessant harassment Symes suffered from the more conservative elements of Victorian public life including multiple prosecutions.[657] The anarchists formed a separate society in 1886, initially maintaining relations with the ASA. However in 1888 open hostility broke out leading to struggles over the ASA property—both legal and physical. Within two years a supporter of Symes had been accidentally killed while defending the Hall of Science from being retaken by the anarchists.[658]

Both freethought and natural theology, and their associations with astronomy would continue on into the twentieth century. In 1910, noted freethinker Joseph McCabe made the first of several tours of Australia lecturing on scientific topics including astronomy and evolution. (Like Proctor he would adopt an evolutionary framework for understanding the history of Earth; unlike Proctor he would argue that we had nothing to fear from comets.[659]) On the other hand, Agnes Clerke, who was the author of *A Popular History of Astronomy during the Nineteenth Century,*[660] continued writing into the

[657] Smith, 'Joseph Symes and the Australasian Secular Association', *Labour History*, 1963, 26–47.

[658] 'Extraordinary Shooting Occurrence', *Age*, 27 Jun. 1890, p. 5.

[659] 'The End of the World', *Advertiser*, 1 Aug. 1910, p. 9.

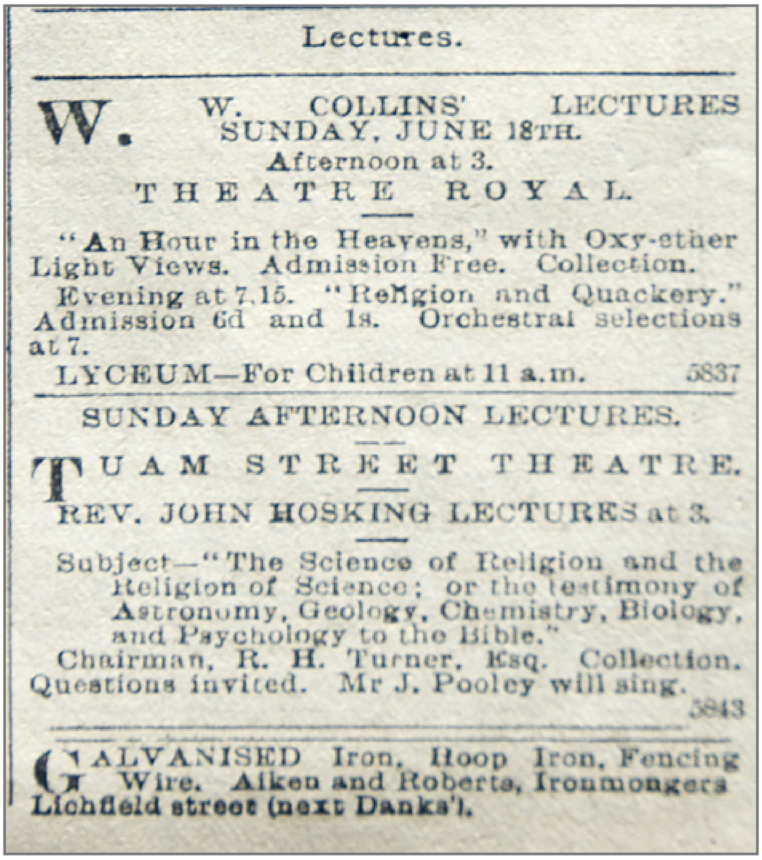
[660] Clerke, *A Popular History of Astronomy During the Nineteenth Century*, 1885.

twentieth century with a natural theology perspective.[661] However compared to earlier rhetoric, both of these were relatively restrained. Neither freethought nor natural theology would achieve the level of prominence that they earlier enjoyed.

Yet the association of ideas involved in linking astronomy with science, history, progress, and contested visions of theology proved to be more durable than the associations of individuals that comprised the freethought movement. Almost every generation since the late nineteenth century has seen significant popular works that have reprised the conflict thesis. The 1930s, for example, saw several popular works from the Marxist scientists described by Werskey.[662] The schema that connected scientific knowledge with anti-clerical feeling has been able, for many people, to organize large and significant aspects of meaning with a framework that was easy to perceive. Significantly for the purposes of this thesis, these associations between astronomy and religion were also easy to mobilise, able to be consciously manipulated and deployed for particular rhetorical effects.

[661] Lightman, 'Victorian Sciences and Religions', *Osiris*, 2001, 343–66.

[662] Werskey, *The Visible College: A Collective Biography of British Scientists and Socialists of the 1930s*, 1988.



Lectures.

W. W. COLLINS' LECTURES SUNDAY, JUNE 18TH.

Afternoon at 3.

THEATRE ROYAL.

"An Hour in the Heavens," with Oxy-ether Light Views. Admission Free. Collection.

Evening at 7.15. "Religion and Quackery." Admission 6d and 1s. Orchestral selections at 7.

LYCEUM—For Children at 11 a.m. 5837

SUNDAY AFTERNOON LECTURES.

TUAM STREET THEATRE.

REV. JOHN HOSKING LECTURES at 3.

Subject—"The Science of Religion and the Religion of Science; or the testimony of Astronomy, Geology, Chemistry, Biology, and Psychology to the Bible."

Chairman, R. H. Turner, Esq. Collection. Questions invited. Mr J. Pooley will sing. 5843

GALVANISED Iron, Hoop Iron, Fencing Wire. Aiken and Roberts, Ironmongers Lichfield street (next Danks').

Source: Christchurch City Libraries

Figure 5.1 Advertisements for astronomical lectures by Collins and Hosking, 1893

On June 18 1893, William Whitehouse Collins and the Rev. John Hosking would deliver astronomy lectures simultaneously, just a few kilometres apart. The former would attempt to show that a rational universe needed no god, the latter would defend natural theology. While this timing is a historical coincidence, it is a remarkable fact that at the same time, in almost the same place, very similar content could be used for completely different purposes.

Both lecturers drew on the cultural schema of astronomy as giving insight into religion.

5.3 Labour movement: popular science and workers' education

The freethought movement was only one strand of radical politics at the end of the nineteenth century, and not the largest or most influential. Trade unions and the labour movement were the most politically significant, while this period also saw the rise of the organized women's movement. This section contextualises the use of popular science and astronomy in the freethought movement within the broader politics of popular education in the wider political environment. The cultural schemata that made astronomy an appealing subject for freethinkers were also significant for other radical activists, although in general there were other forms of popular science and education that were more important.

It is notable that astronomy was explicitly invoked throughout this wider environment. In particular, Joseph Symes was far from the only person to claim that it was a study of astronomy that turned him to radicalism. Another was the British trade unionist Tom Mann, who was active in Australia between 1902 and 1909 as an organizer firstly for the Labor Party, and then later for the Victorian Socialist Party. Mann cited astronomy in particular as one of the major influences behind his self-education and subsequent radicalisation: "What little knowledge I have gained has come through study in night schools and through reading—chiefly political economy, physical science and astronomy".[663]

There were two main impulses behind the socialist support for science. Firstly, many different types of nineteenth century socialists—notably, but not exclusively Marxists—

[663] 'An English Leader', *Worker*, 26 Aug. 1899, p. 2.

saw their movement as based on scientific principles of history and sociology, and thus support for socialism involved a support for scientific endeavour, and vice versa. Secondly, on an individual level, education was seen as the main way in which workers could improve their lives. This echoed the mid-century philosophy of rational recreation but with an important difference. While for the earlier approach, popular education was oriented to the goal of teaching the working classes to emulate the middle classes, for late-century socialists, education was a means for the working classes to achieve autonomy.

The major subjects regarded as important for such socialist popular education were political economy and sociology (which for many at the time meant the teachings of Herbert Spencer). Nonetheless, popular science and astronomy had a place in this curriculum. Louis Gross, Melbourne correspondent for the German socialist organization Verein Vorwarts advised the *Worker*, after treating political economy, to "teach the readers a little in natural science, modern philosophy, astronomy &c".[664] This would be preferable, he suggested, than discussion of religious matters.

A few years later, the *Worker* would take up this course of action with respect to astronomy. Harald Ingemann Jensen,[665] under the pen name of H Ingemann, would write a series of popular science columns, the first three of which were devoted to astronomy.[666] Jensen had a number of goals in this course of action. One was to provide a more cosmopolitan perspective. Previously in Australia, the limited science education had a nationalistic British focus: "If science is touched upon only British names are mentioned such as Newton, Herschel, and Faraday".[667] Beyond this, Jensen would, like so many others, appeal to the astronomical sublime as a motivation for self-improvement.

---

[664] 'Political Pellets', *Worker*, 2 Mar. 1895, p. 3.

[665] McFarlane, 'Jensen, Harald Ingemann (1879–1966)'.

[666] Ingemann, 'In the Sea of Science. The Stellar World', *Worker*, 31 Mar. 1900, p. 2; Ingemann, 'In the Sea of Science. The Stellar World', *Worker*, 7 Apr. 1900, p. 2; Ingemann, 'In the Sea of Science. Composition of the Heavenly Bodies - Meteorites', *Worker*, 14 Apr. 1900, p. 2.

[667] Ingemann, 'Science and Knowledge', *Worker*, 24 Mar. 1900, p. 2.

> The study of science which shows man his own insignificance and the immensity of the universe; the distribution and gradations of life; the marvels of the air, the land and the sea; which opens to him the book of Nature, is one of the best means of mental evolution.[668]

Like so many others Jensen placed astronomy as the first science; again, like so many others, he would hark back to ancient ideas about astronomy to show the development of human thought. Overall his treatment is generally unremarkable—other, perhaps, than a particular looseness with historical accuracy. He presents his facts in a relatively old-fashioned way, even alluding to the dialogue genre of a previous generation.

The series of articles by Jensen, and the role of popular science in the labour press generally, testifies to the persistence of the idea that scientific knowledge was a pathway to liberation for the down-trodden working classes. That astronomy continued to have a place in this discourse supports the general cultural value accorded to that science; that astronomy was considerably less prominent in labour politics than in freethought politics suggests that there were specific aspects of the cultural schemata of astronomy that were deployed by the latter. While the schema of astronomy as an exemplary science was useful in both contexts, the schema of astronomy as giving insight into religion was useful only for the freethinkers, and not for labour activists in general.

The interest in working-class education was not confined to socialists. Although the original Mechanics' Institutes or even the subsequent Workingmen's Clubs, as described in § 2.6 had ceased to fulfil their mission of such education, at the end of the nineteenth century more formal adult educational organizations were established. These included university extension lectures in a number of colonies, and the establishment of the Working Men's College in Melbourne in 1887. Astronomy played a part in these educational efforts as well. In both Victoria and Tasmania some of the first University Extension lectures were given on the subject of astronomy by Ernest Love, demonstrator on physics at Melbourne University, in the former case and by Frederic Young, a member

[668] Ibid.

of the University of Tasmania Council in the latter.[669] At the Melbourne Working Men's College (later to become the Royal Melbourne Institute of Technology) Government Astronomer Robert Ellery delivered a number of lectures to the Working Men's College, including in 1887 and 1895.[670]

[669] 'University Extension Board', *Argus*, 7 Apr. 1892, p. 9; 'University Council', *Mercury*, 22 Jan. 1895, p. 2.

[670] 'Tenants of Space', *Ballarat Star*, 11 Aug. 1887, p. 4; 'Weather and Weather Prophets', *Argus*, 16 Sep. 1895, p. 6.

5.4 Uses by the scientists

5.4.1 Uses of popular science by elite astronomers

Ellery's talks to the Working Men's College were far from the only public presence that he had. From at least 1870 until the end of the century he was "Victoria's man of science, especially in those areas where science intersected with everyday applications".[671] Nor would Ellery be the only 'man of science' in the colonies. In South Australia Charles Todd and, slightly later, in Queensland Clement Wragge both had commanding public presences. New South Wales government astronomer Henry Chamberlain Russell was a slightly more reticent public figure but even he would present a vision of science through the popular press. The interests of these scientists were based substantially on the imperatives of their organizations, and their popular communications reflected this.

McLeod identifies the period up until the 1870s as the first stage of science in Australia, or as the *Adelaide Observer* would later describe it the "pioneering" phase in which interest is directed towards "Scientific exploration and the classification of plants and animals", "Anthropology as studied in connection with wild and savage tribes" and "geology as applied directly to the search for minerals".[672] In another seminal study, Inkster and Todd describe three reasons for this focus on natural history and anthropology: the utilitarian value of studying resources, the colonial structure of the scientific enterprise, and the psychological appeal for new settlers in understanding their new environments. From the 1870s and through the 1880s scientific work became increasingly more organized. At this time the first attempts at inter-colonial cooperation commenced, the colonial universities

[671] Gillespie, *The Great Melbourne Telescope*, 2011, p. 127.

[672] 'Scientific', *Adelaide Observer*, 18 Jan. 1890, p. 41.

started incorporating more scientific research and teaching into their activities, and governments employed an increasing number of workers with backgrounds in science and technology, such as agricultural scientists and railway engineers.[673]

A key event in this stage was the formation of the Australasian Association for the Advancement of Science in 1888. According to McLeod, this event was the result of "a small community of men and women on the fringes of Empire, who appropriated a British culture of science and directed it to colonial and national purposes".[674] From the public point of view, it formed another focus for the attention of the press and, importantly, one that had a national presence.

With this increased professionalization came a corresponding change in the public profile of science. This change had multiple aspects. On the one hand, there was widespread recognition of the products of science such as the electric telegraph, gas lighting, and synthetic dyes as essential to daily life. On the other hand it is from this time that we start to see the stereotypes of the scientific worker as lacking in common sense, as narrow in interests and, and above all, as boring, as shown in the cartoon in Figure 5.2.

The concerns of government with public science had a particularly strong relationship with popularization. In very large part, the interests of government-sponsored science revolve around the problems of the constituents of government, and a significant part of this work involves consultation with and persuasion of those constituents.

In Australia this included a strong focus on agricultural science, as was common in other colonial environments.[675] One example of this focus was the introduction of anthrax vaccine for livestock in Australia in the 1880s. The successful implementation of these techniques by government scientists such as Alexander Bruce and Edward Stanley

[673] MacLeod, *The Commonwealth of Science*, 1988, pp. 22–25; Inkster and Todd, 'Support for the Scientific Enterprise, 1850-1900', 1990, pp. 102–9; Todd, *Colonial Technology*, 1995, pp. 25–26.

[674] MacLeod, *The Commonwealth of Science*, 1988, p. xi.

[675] Inkster and Todd, 'Support for the Scientific Enterprise, 1850-1900', 1990, pp. 102–9.

required not just clinical trials, but also meetings with stockowners, addresses to conferences, a campaign in the press and lobbying of government members.[676] As with earlier examples, the public role of popularization here merges with the laboratory work of science.

As discussed in §§ 2.3–4, the public science functions of astronomical observatories were important and these were amongst the first scientific institutions supported by governments, both in Britain and in colonial Australia. The Sydney, Adelaide and Melbourne Observatories had been founded in 1858, 1860 and 1862 respectively. (The last of these had been preceded by the Williamstown and Flagstaff Observatories which merged in the move to South Yarra.) All of these provided a nucleus for public discussion of astronomy. Indeed in the case of both Sydney and Melbourne this discussion began even before the Observatories were constructed. A campaign to re-establish an Observatory in Sydney began almost as soon as the Parramatta Observatory was disbanded in 1847; by 1855 the campaign had the support of Governor William Denison.[677] Nonetheless, within a year of its opening, equally public "grumblers" were complaining about the expense entailed.[678] In Victoria, the foundation of the Williamstown Observatory was prompted by a letter to the editor by Robert Ellery in 1853 in which he complained about the standard of public time in the Victorian colony.[679]

A relatively mundane, though no less influential way in which these institutions contributed to public knowledge was through astronomical notices to newspapers and almanacs. Ellery, and his staff at the Melbourne Observatory (like assistant Edward White who supplied the almanac reports for many years) were particularly active in this regard. More than most:

---

[676] Todd, *Colonial Technology*, 1995, pp. 36–44.

[677] 'Observatory', *Sydney Morning Herald*, 20 Feb. 1851, p. 2; Denison, William, 'Observatory', *Sydney Morning Herald*, 28 Jun. 1855, p. 2.

[678] '(No Title)', *Empire*, 19 Aug. 1859, p. 4.

[679] Ellery, Robert J, 'Time', *Argus*, 7 May 1853, p. 9; Clark, 'Influences of German Science and Scientists on Melbourne Observatory', *Proceedings of the Royal Society of Victoria*, 2015, 43–58.

> Ellery made himself available to reporters, whether it be to comment on the weather, the latest comet, advances in telegraphy, public time, or any of the other subjects on which he seemed to be the local ‘talent’.[680]

The Melbourne Observatory developed several other public products. The use by Proctor and Pepper of the Observatory’s lunar photographs were described in Chapter 3. Joseph Turner’s photographs would be distributed far more widely, including at international exhibitions, but also schools and Mechanics’ Institutes locally.[681] Edward White’s planisphere was also distributed to schools.[682] (see Figure 5.3.) All of this work went far beyond the narrowly technical concerns of the Observatory. Instead they reflected an interest in establishing the Observatory as a valuable public institution, and meeting the needs of schools was clearly an important way of doing this.

All of the government astronomers also delivered popular lectures with more or less regularity. Ellery delivered lectures at the Melbourne Athenaeum in 1857 (when he was in charge of the Williamstown Observatory), at the Technological Museum in 1870 and at the Bendigo School of Mines in 1882, and to many clubs and societies in between, including the Early Closing Association in 1870.[683] While Ellery’s lectures were clearly intended to be educational he was also careful to draw attention to the practical benefits flowing from the Observatory of which he was in charge. In his lecture at the Technological Museum in 1870 on “Common Uses of Astronomy”, for example, he described the role of Observatories in setting an accurate time, and looked forward to when “most of the clocks displayed for the benefit of the Melbourne public”[684] would be linked with the Observatory. Nor does it seem a coincidence that he was most actively

[680] Gillespie, *The Great Melbourne Telescope*, 2011, p. 125.

[681] Ibid., pp. 124–25.

[682] ‘News of the Day’, *Age*, 5 Nov. 1881, p. 4.

[683] ‘Mr Ellery’s Lecture’, *Williamstown Chronicle*, 20 Jun. 1857, p. 3; ‘(No Title)’, *Argus*, 21 Oct. 1870, p. 5; ‘School of Mines Popular Science Lectures’, *Ballarat Star*, 6 Jul. 1882, p. 4; ‘Progress of Astronomy - Mr Ellery’s Lecture’, *Leader*, 30 Jul. 1870, p. 12.

[684] ‘Progress of Astronomy - Mr Ellery’s Lecture’, *Leader*, 30 Jul. 1870, p. 12.

lecturing around 1870 when the Great Melbourne Telescope was the subject of public controversy.

Ellery's successor as Victorian Government Astronomer, Pietro Baracchi, was nearly as frequent a lecturer. Baracchi was happy to go beyond the theme of practicality and employ other popular schemata, such as the importance of the Southern Cross to Australians,[685] or the possibility of life on other planets.[686] (See Figure 5.4.) Charles Todd, in South Australia, prolific in so much else, was not a frequent lecturer, but did contribute regular columns on astronomical information to the newspapers, and at least some of the slack was taken up by his assistant at the Adelaide Observatory R. F. Griffiths. William Cooke, another assistant of Todd's who went on to become Government Astronomer in Western Australia in 1896 and then in New South Wales from 1912 was a frequent lecturer who travelled to audiences across the colony (later state). In 1902 the *Coolgardie Miner* noted that "The astronomer's services are not intended to be solely for the use or entertainment of the metropolis and its suburbs";[687] when Cooke lectured there two years later the benefits to the goldfields of the Government Astronomer were presumably noted. In New South Wales, Henry Chamberlain Russell was not as prolific as his successor, but nonetheless gave numerous public lectures. He also used his public presentations to justify and promote the Sydney Observatory's expeditions, such as the Transit of Venus expeditions described in § 2.5.2. As with the public products produced by the Melbourne Observatory, justifying government funding for astronomy was an important task for Russell, and popularization was one of the chief means through which this was done.

Tasmania was a colony without an official observatory although an attempt to secure one for the colony provided an example of the importance of public lecturing to astronomy. Arthur Leake, the last surviving son of a wealthy grazing family, died in 1890. In his will

---

[685] Baracchi, *The Stars on the Ensign of the Australian Commonwealth*, 1902.

[686] 'Other Worlds', *West Gippsland Gazette*, 7 Nov. 1899, p. 3.

[687] 'Scientific Lectures', *Coolgardie Mine*, 17 Jun. 1902, p. 2.

he left three bequests: two to establish scholarships in painting and sculpture, and one to establish a school of practical astronomy, including funds for the purchase of equipment. It was a condition of this latter grant that the astronomer undertake "demonstrative lectures with diagrams and instruments".[688] As it happened, the bequests never came to fruition. There was protracted legal action over the value of the estates and by the time that was resolved in 1896, Leake's niece Letitia learned that her uncle, who was her guardian, had been embezzling from her trust account. She challenged the will, and the Attorney General for Tasmania Andrew Inglis Clark settled the case, ceding the claim of the government over the bequest funds.[689] No record exists within the surviving Leake Archives about the precise genesis of Arthur Leake's interest in astronomy, but his view of the ideal astronomer was perhaps inspired by Proctor's example. In any case he saw this public role as an essential component of official astronomical work.

Queensland was also without a government astronomer in the 1890s, but it did have a Meteorological Observer—Clement Lindley Wragge.[690] Yet another colourful figure in Australian popular astronomy, Wragge has proved an attractive personality for Australian historians. In cultural memory he managed to largely overshadow his predecessor as Queensland rain-maker, Professor Pepper. In many ways, Wragge 'proves the rules' that have been described in this section: a government scientist, he also operated as a commercial entrepreneur; part of the new professional class, he deployed his authority like an older-style savant; devoted to scientific rigour, he was increasingly attracted to Theosophy through his life. A consummate communicator, Wragge attempted to persuade others of his authority, of his theories, and for his own commercial interests.

Born in 1852 and orphaned at a young age, Wragge briefly visited Australia before returning to Britain and achieving a measure of fame by establishing a weather station at the top of Ben Nevis. In 1884 he returned to South Australia, determined to introduce

688 'University of Tasmania', *Mercury*, 21 Jan. 1891, p. 1.

689 'Equity Jurisdiction', *Mercury*, 2 May 1896, p. 1.

690 Wilson, 'Wragge, Clement Lindley (1852–1922)'.

scientific techniques of meteorology. From early on in his time in Australia he also (self) promoted a commercial style of popular science.[691] He was successful in some respects; in 1887 he was appointed to the position of Queensland Meteorological Observer, where he would remain for 16 years. In his time as the government meteorologist, Wragge mostly gave public lectures on the weather, although even then he would work in references to astronomy, which was “the most sublime of all the sciences” but “meteorology had infinitely more to do with the welfare of these colonies than the efforts of astronomers to discover new asteroids or comets”.[692] In this time he also managed to put off-side most of the other colonial Astronomers and Meteorologists through styling himself as the “Principal Meteorological Office” of Australia, and issuing forecasts for other colonies. When he resigned from his post in 1903 he returned to more commercial pursuits: lecturing and the creation of a popular science magazine. In his farewell tour he turned to astronomy as his lecture subject[693] and this remained his main speaking topic in his post-government career, although he was also fond of demonstrating the radioactive properties of radium, In 1907 he moved to New Zealand and continued lecturing. His theosophical outlook was imbued into his lectures; he was forthright in averring his belief in the “Supreme Being”[694] and also in the plurality of inhabited worlds.[695] He was sufficiently charismatic as a lecturer that his expansive and speculative style of speaking was referred to as “the Clement Wragge method”,[696] against which the freethought orator Collins appeared measured and factual. In any case, Wragge continued to prove popular with audiences. Far from a characteristic professional scientist, he nonetheless embodies many of the arguments of this thesis.

---

[691] ‘Advertising’, *Evening Journal*, 19 May 1886, p. 1.

[692] ‘Scientific & Useful’, *Queenslander*, 12 May 1894.

[693] ‘Mr C. L. Wragge’s Farewell Lecture’, *Queensland Times, Ipswich Herald and General Advertiser*, 12 Jun. 1902, p. 7.

[694] ‘The Yea Chronicle’, *Yea Chronicle*, 19 Nov. 1903, p. 2.

[695] ‘Are There Other Worlds Habitable by Man?’, *Brisbane Courier*, 10 Jul. 1902, p. 8.

[696] ‘Other Worlds than Ours’, *Southland Times*, 15 Nov. 1910, p. 5.

With respect to more conventional professionals, this thesis has described a complex of related processes. Government-funded science was becoming more prominent, and the colonial observatories were leaders in this regard. Scientists were increasingly professionalising and forming societies; a natural consequence was the need to maintain public and political support for these projects. The rise of photography and the associated visual epistemology of mechanical objectivity enhanced the status of those able to capture those images, which is to say practicing astronomers, while the authority of the 'local scientific gentleman' was eroded. All of these contributed to the role, and nature, of popularization for the practicing astronomer.

These developments are occurring at the very end of the historical period of interest for this thesis. Just outside this period, for example, are both the meetings of the British Association for the Advancement of Science in Australia in 1914, and, the year before, the tour of Australia and New Zealand by Mary Proctor, 33 years after her father's, in order to raise awareness of and funds for a proposed solar observatory in Australia. The background of this latter story was outlined in § 3.7.2, starting as a request by Walter Duffield, with Mary Proctor asked on the recommendation of Robert Ball. It is a particular example of popularization clearly deployed for the purposes of astronomical science, and a story which has been marginalised in favour of the more traditional accounts focussing more exclusively on the role of Duffield—but it will not be told here either. As described in the conclusion to this thesis, these are matters of future interest.

5.4.2 Uses of popular science by amateur astronomers

Professional astronomers had a particular interest in defending their position but they were of course not the only astronomical practitioners contributing to popularization. Amateur astronomers were often the most enthusiastic and active participants in the activity. The particular role of amateur astronomers has been well-studied by Orchiston;[697] I will here make a few observations on this role.

One feature of John Tebbutt, the famous comet-hunting amateur, was that he was particularly sensitive about his reputation, and distrustful of government astronomers' support for amateur activities.[698] He had a particularly ongoing feud with New South Wales government astronomer Russell.[699] The public press was one of the main arenas in which this contest was played out, thus ensuring that this avenue of popularization was highly persuasive, and political in intent. John Tebbutt's interventions into religious discussion can be seen in a similar light. Tebbutt was a devout Christian, but his theology was not entirely orthodox. He was not averse to using his astronomical lecturing to promote his viewpoints here, both condemning freethought but also suggesting the need for religious reform.[700]

Amateur astronomers could also have highly motivated communications for commercial reasons as well. The 'street astronomer', who would earn money from passers-by for showing them astronomical subjects through the telescope, is a good example here. Street astronomers were reported in Melbourne, Adelaide, Newcastle and Bendigo.[701] No doubt

697 Orchiston, 'The Role of the Amateur in Popularizing Astronomy', *Australian Journal of Astronomy*, 1997, 33–66.

698 Orchiston, 'Comets and Communication', *Publications of the Astronomical Society of Australia*, 1999, 212–21.

699 Orchiston, 'Power, Politics and Prestige: The Russell–Tebbutt Feud', 2017, pp. 393–448.

700 Tebbutt, *The Testimony Which Astronomy Furnishes to the Attributes of the Creator*, 1878.

701 'The Streets of Melbourne', *Illustrated Australian News for Home Readers*, 13 Apr. 1874, p. 60; 'Municipal Corporations. Correspondence', *South Australian Register*, 9 Oct. 1872, p. 3; 'Local and General News', *Newcastle Morning Herald and Miners' Advocate*, 4 May 1886, p. 5; 'Astronomical Chat', *Bendigo Advertiser*, 9 Jun. 1886, p. 1.

they were far more widespread. They were certainly well-known enough to be a subject of fun. (See Figure 5.5.)

On the other hand, amateurs also provided many of the popularizations that did come closest to the 'informative' ideal of popular science. Notable in this regard are the activities of Dudley Eglinton in Brisbane, who contributed newspaper columns on astronomy to the Queensland newspapers from 1900 until shortly before his death in 1937.[702] Eglinton was also a popular lecturer, and one of the forces behind the foundation of the Brisbane Astronomical Society in 1896.[703] It was around this time that astronomical societies were founded around Australia—local societies in South Australia and Queensland, and branches of the British Astronomical Society in New South Wales and Victoria. There had been unsuccessful earlier attempts to form such societies but by the 1890s there were sufficient numbers of active amateurs in the major cities to support such societies.[704] While the activities of these organizations were primarily focussed on supporting the astronomical practices of their members, most of the societies did hold public lectures and, like Eglinton, many of their members undertook more widespread popularizations.

Elite, amateur and commercial astronomers alike shaped their practices of popularization in order to motivate and persuade their audiences. This involved both local rhetorical moves, as described with Richard Proctor, but also the harnessing of broader cultural meanings that were understood by audiences. In this respect the persuasive elements of their performances were similar to those of freethought and labour lecturers.

[702] Eglinton, 'Astronomy. Astronomical Notes for March', *Queenslander*, 3 Mar. 1900, p. 430; 'The Southern Cross', *Daily Mercury*, 23 Nov. 1936, p. 8.

[703] 'Proposed Astronomical Society', *Brisbane Courier*, 13 May 1896, p. 4.

[704] Orchiston, 'Amateur-Professional Collaboration in Australian Science', *Orchiston, W. (1900). Amateur-Professional Collaboration in Australian Science : The Earliest Astronomical Groups and Societies.*, 1998, 163–82.

Source: State Library of Victoria

Figure 5.2 'Australasian Society of Mutual Bores', 1888

By the end of the nineteenth century, the trope of a scientist as someone who is lacking in common sense, has narrow interests and is boring had become commonplace. While this stereotype has a long history, to a significant extent it was enhanced by the professionalization of science, which both enhanced specialization and moved the forums of scientific discourse further away from public discussion.

This cartoon appeared as part of the front cover illustration for the *Bulletin* on 8 September 1888.

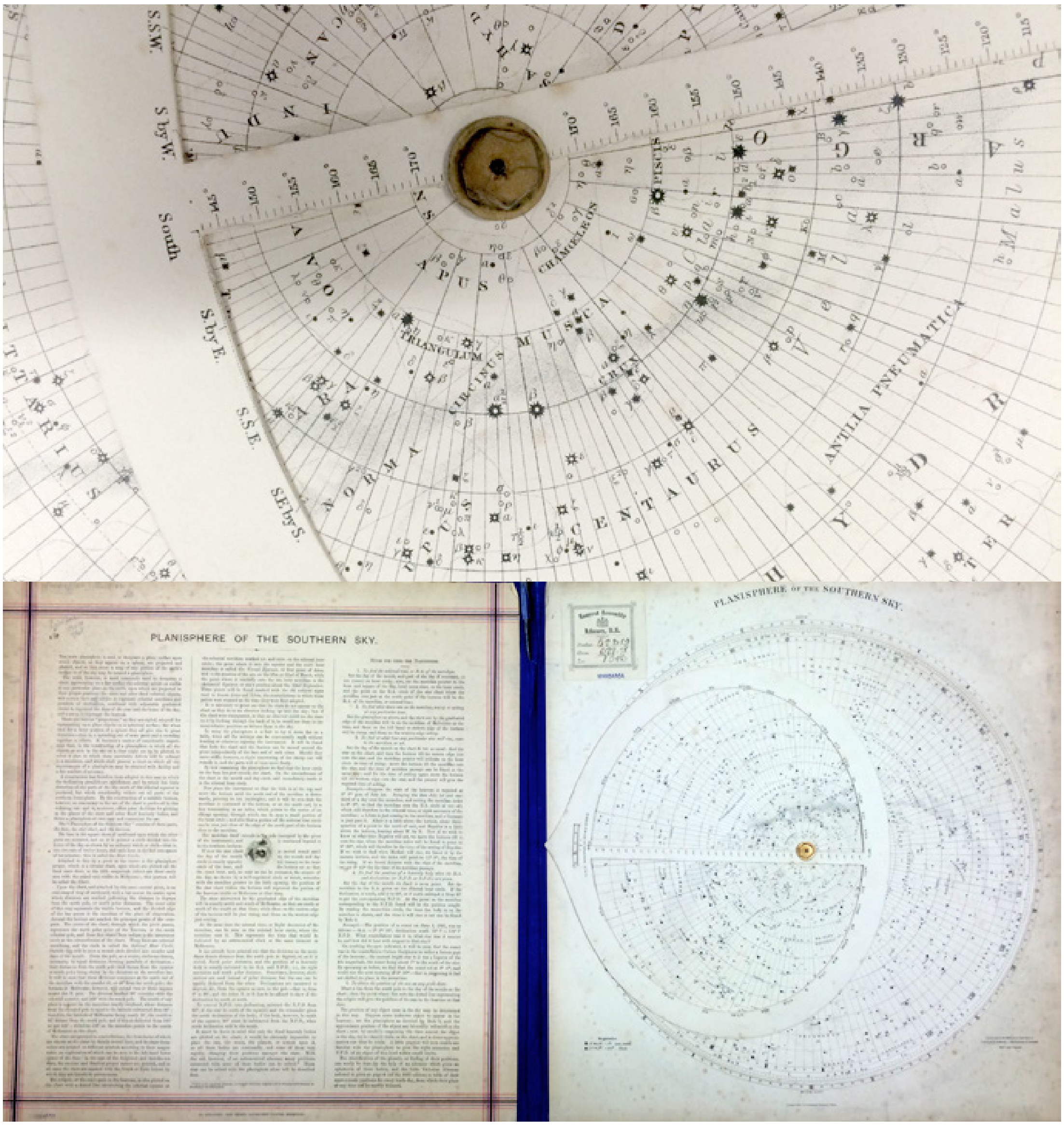


Figure 5.3 'Planisphere of the Southern Sky', 1881

Planispheres are a map of the sky that are able to show which stars will be visible at a given time on any day of the year. This planisphere was designed by Edward White, assistant at the Melbourne Observatory, in 1881. Two thousand copies of it were distributed to schools in Victoria free of charge.

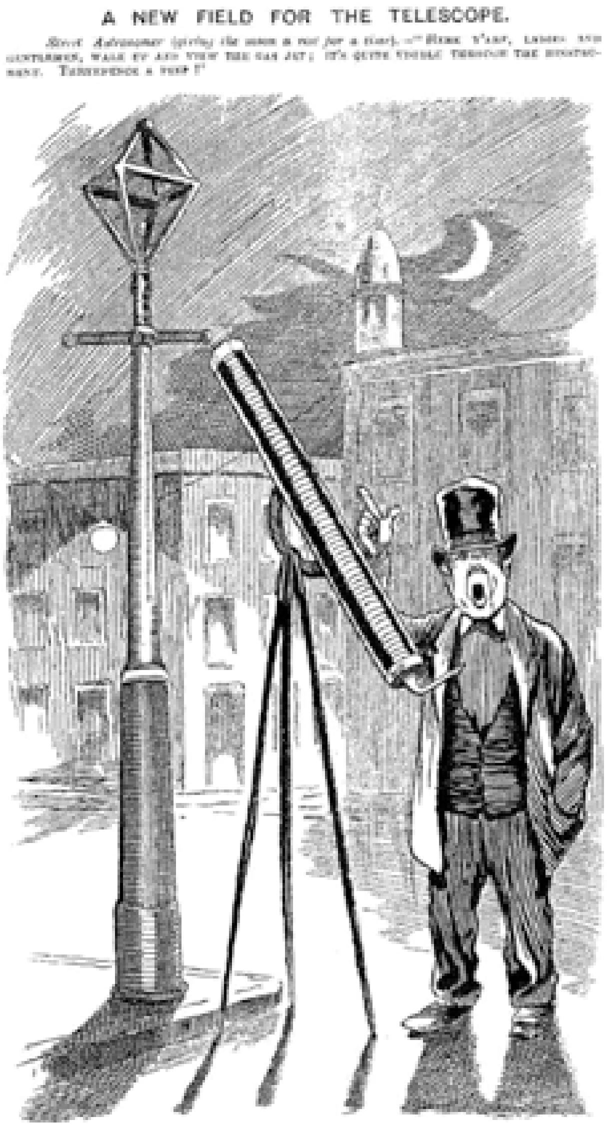
Like all government astronomers, Robert Ellery of the Melbourne Observatory had an interest in justifying public expenditure. Promoting science to the public, and in particular fulfilling the needs of schools, was an important way of doing this.

Source: Trove

Figure 5.4 Images from newspaper report of Baracchi lecture, 1899

These images were printed in the *West Gippsland Gazette* on 7 November 1899 to accompany a report of Victorian Government Astronomer Pietro Baracchi's lecture concerning the possibillity for life on other planets.

The cultural schema of astronomy as giving insight into the human condition through the consideration of life elsewhere has been one of the most longstanding one of popular astronomy. Discussions of it go back to ancient times, and it is still used by popularizers today to generate interest. The issue has also been considered important by many because of its implications for religious ideas, although the precise questions at stake have changed considerably over time.



Source: Trove

Figure 5.5 ‘A New Field for the Telescope’, 1890

This cartoon appeared in *Melbourne Punch* on 25 September 1890. The street astronomer was clearly a well-known figure in many places. Jokes about street astronomers had appeared in *Melbourne Punch* for years. Their presence was also recorded in more sober accounts as well.

5.5 Conclusion

The case studies of popular astronomy in this chapter are diverse but they have a common aspect. All of the popularizers studied claimed to be interested in spreading knowledge and educating, yet they all used popularization in an attempt to persuade and motivate people: for or against organized religion, for radical politics, for gaining public and political support for elite astronomy, or for enhancing the prestige due to amateurs.

The persuasive aspects of the subjects in this chapter cannot be considered as peripheral or secondary; they were integral to the popularization activities themselves. The motivations for these lectures did not just inspire the undertaking of these activities, they shaped the content of what was communicated. Certainly this was true to varying degrees: Collins' descriptions of a rational universe was the main motivation for his presentations; the emphasis by Government Astronomers on the practical value of publicly funded Observatories was an important aspect, but only one aspect, of their activities; the newspaper columns of Dudley Eglinton come close to fulfilling the ideal of informative communication, the persuasive element of which is to encourage readers to read on, and perhaps join the astronomical community. Nonetheless, regardless of the level of persuasive motivation, in all of these cases the motivations of the popularizers shaped the content and structure of their communications.

The nature of popularization as existing within a continuum of communication, addressing multiple audiences and fulfilling multiple agendas simultaneously has been noted throughout this thesis. So too has the permeable boundary between persuasive and informative communication been noted in various contexts, for example the role of entertainment in promoting health messages, or psychological techniques to stimulate behaviour change with respect to environmental outcomes.

A focus on the persuasive aspects of popularization is useful because it goes beyond the self-image of popularizers as disinterested, informative communicators, whose role was "the art of imparting the unadorned facts of science in such a manner as to interest and attract the uneducated popular ear".[705] This focus reveals deeper aspects of their practice, and gives a lens on how the cultural schemata of astronomy operated in popular science.

These uses of popular science as persuasive are able to be effective precisely because popularizers were able to connect the meanings of science with broader concerns of their audiences through the use of cultural schemata. Particularly evident here is the schema in which astronomy gives us insight into religion, and therefore discussions of astronomy can be used as either a weapon against, or a defence of, religion. The schema of astronomy as an exemplary science was also a background for socialist educators promoting a rational education.

As with earlier discussions of the operations of schemata in culture, it is the case that social and political arrangements need to be included. The institutionalisation of astronomical science led to a central focus for the organization of astronomy in the public realm, and also suggested the ways that elite astronomers would attempt to persuade—they were quick to highlight the broader value of knowledge practices as useful in defending public funding for their observatories. Nonetheless, even these uses of popular astronomy are shaped by the longer cultural histories of schemata. The schema of life on other planets, for example was one that even serious government astronomers like Baracchi and Todd were willing to invoke in order to gain interest.

Previous chapters have outlined the cultural schemata of astronomy, given case studies of their use and detailed the technologies through which they were manifested. This chapter has provided cases studies of their deliberate deployment in order to reveal them more fully. We are now ready to overview the operation of cultural schemata in popularization, and how they inform us of the practices of popular astronomy in colonial Australia.

[705] 'Professor Denton's Lectures', *Bendigo Advertiser*, 28 Sep. 1881, p. 3.

6: Understanding Australian Popular Astronomy

There are four major arguments of this thesis. First, the public knowledge practices of popular astronomy are intimately connected with the technologies of visual and material communication. The lantern slide was a particularly high-impact medium in this regard. Second, the unique set of cultural schemata involved in popular astronomy makes it distinct from other forms of popular science. Third, practices of astronomical popularization change on multiple timescales—the fast beat of scientific discovery is set into the slower, more stable rhythms of cultural schemata. Finally, the local performance of these practices shaped the identities of colonial Australia in a particular way while simultaneously being tied into a worldwide trade in knowledge and entertainment. Astronomy is a notable factor in sustaining the global imagination of colonial Australians.

This thesis has described aspects of colonial popular astronomy as understood by its nineteenth century participants through five main cultural schemata: Australia is a land under the southern stars; astronomy tells of a sky that is a source of power and danger; astronomy gives us insight into religion; astronomy is an exemplary science; and astronomy speaks to the human condition through the possibilities of life elsewhere. (The combination of the second and third—and to some extent the fifth—of these has been described as the *astronomical sublime.*) All of these have been shown to be durable cultural resources that both reflected and shaped the interpretations of colonial Australians' experiences.

I will focus on the four analytical arguments of this thesis in this conclusion; only the first of the schemata will be discussed more fully. The schemata framework was an analytical choice rather than an outcome of the thesis. This conclusion draws on the evidentiary basis of the cultural schemata that have been elucidated as justification for the analytical claims. Nonetheless, another argument of this thesis is that a conceptualization of cultural schemata is a productive way of describing the questions uncovered by this study, such as the problem of multiple timescales. Conceiving of cultural resources as shared, but not totalizing can help to explain change, like the fading of the rational recreation tradition described in § 2.6, while thinking of cultural schemata as networks can help make sense of the way that specialist information comes to have personal meaning for non-specialists, as this scientific knowledge becomes associated with cultural resources from very different domains of understanding.

This concluding chapter will also describe ways in which this study could be extended in the future.

6.1 Astronomical popularization was intimately connected with visual and material practices

The visual communication employed by popular astronomy has been a major theme of this thesis. The periodization of the study is based—in part—around the magic lantern. This technology was the most engaging visual format for much of the nineteenth century and all of the high profile popularizers studied in this thesis employed it. Lanterns were, of course, not the only format for visual communication. Illustrated books and magazines were highly influential, while popular astronomy's use of physical models like orreries was also significant. All of these visual technologies had an impact on the practices of popular astronomy.

A particular function of visual communication in popular astronomy was that it stabilised and magnified practices. Processes of stabilisation included the development of conventional forms, in terms of both content and media, that were understood and expected by audiences. These conventional forms derived from, and in turn facilitated the material trade in lanterns, slides and books that have been described in this thesis. In particular, the prepared commercial lantern set, with slides such as those in Table 4.1, became an important resource for a wide range of lecturers.

The visual and material technologies also magnified the practices of popular astronomy. The magic lantern enabled a larger audience to be assembled, and consequently, promised to the commercial practitioner, like John Meredith, the opportunity for greater returns. For non-commercial lecturers, such as the proselytisers like William Whitehouse Collins and John Hosking who were more concerned with persuasion than profit, the conventional sets allowed additional layers of meaning to be elaborated more easily, thus spreading the cultural reach of popular astronomy.

Material objects perform social functions; this observation is a key insight of many frameworks for the social study of technology. John Law reminds us that these objects themselves exist as networks that need to be constantly performed. The networks of trade in lanterns and slides, and the spaces in which they were performed were necessary parts of the social apparatus for the stabilisation of popular astronomy as a comprehensible cultural artefact.

One social function of lanterns and illustrated books was to enlist audience members as assistants, as practitioners of science themselves. The motivations of popularizers were diverse, ranging from "commercial to sublime", from earnest to fraudulent, but in all cases those interests were furthered by drawing more people into their networks. In order to do this, the lanterns acted as the scientific instrumentation of the audience, revealing the secrets of nature under the careful superintendence of the popularizer.

Yet popular astronomy was most successful in the hands of practitioners like Proctor or Wragge when it achieved a more symmetrical exchange. Visual and material practices could also enrol the science of astronomy in the interests of the audience: identity and environment, religion and the future, life and death. In the analytical framework of this thesis, popular astronomy invoked pre-existing cultural schemata such as the association of astronomy with religious sensibility. These schemata will now be described.

6.2 Popular astronomy enrolled a distinct set of cultural resources

Successful popular astronomy discussed the observations of the science of the night sky but drew on meanings from a context wider than scientific practice. Moreover, popular astronomy mobilised a specific set of cultural concerns in a way that distinguishes it from other forms of popular science. This has consequences for understanding the various roles of the practitioners, the audiences and the media forms of popularization.

Understanding the meanings of popular astronomy for its audiences requires attention to ideas and concerns that go far beyond those of the study of the night sky. The importance of looking at the social and cultural networks within which the practices of popularization are situated is clear from the literature on popular science, which shows the multiple ways in which the ‘internal’ practices of science interact with wider social processes. This thesis draws attention to the way that more persistent cultural traditions have been mobilised as resources: clusters of separate but related ideas have been consciously and explicitly mobilised by the practitioners of popularisation. These clusters, described within this thesis as cultural schemata, have in many cases been relatively stable over time, allowing a tradition of practice to develop around them. The challenge to extend this framework is to develop without collapsing schemata to a set of stable categories, to retain an emphasis on circulation and fluidity.

The main cultural schemata of popular astronomy have been described throughout this thesis. Firstly, Australia is a land under the southern sky, and the stars in that sky both mark present location and evoke memories of former homes, and in this way speaks to the relationship between the two. Secondly, astronomy tells of a sky that is a source of power and danger that could be manifested by severe weather or by the devastation of a cometary impact. Thirdly, astronomy gives us insight into religion. It describes the largest spatial scales of creation, against which the human size is insignificant, but also a realm of the perfect operation of natural law. The second and third of these in combination have been described as the astronomical sublime, the sense of reverence and wonder evoked by the large, powerful and divine operation of the universe. The fourth cultural schemata of astronomy is that it is an exemplary science, both mathematically more exact than other sciences but also the observations of many of its laws are open to all who can see. In this respect astronomy stands for a history of science, or thought itself—astronomy is frequently described as the first science. Finally, astronomy is thought to speak to the human condition through its consideration of the possibilities of life elsewhere. This was known as the plurality of worlds debate.

Some of these schemata taken individually might be associated with other sciences but this combination of cultural schemata was unique to astronomy. For example mathematics was considered by many as another exemplary science, and geology could invoke its own sense of the sublime through the processes creating mountains and volcanoes, but neither of these sciences suggested both at the same time. This uniqueness has implications for the audiences assembled by astronomical popularization, both in terms of composition and motivation. A direct comparison of the popularizations between different sciences would be instructive in this regard, although here I can only sketch the outlines of what such a comparison would look like. Chemistry, for example, has had a considerably less prominent popular tradition, notwithstanding the influence of works such as Pepper's *Playbook*, and Marcet's *Conversations*[706] in the nineteenth century, or children's chemistry sets in the twentieth. Medical science, on the other hand has always been of interest in the popular media. Yet, despite its direct implication in matters of life and death, and its role in in fierce public controversies, like that of the late-19th century debate over compulsory vaccination, medical science very rarely addressed questions of global life and death in the way that astronomy did.

[706] Pepper, *The Boy's Playbook of Science*, 1866; Marcet, *Conversations on Chemistry*, 1853.

One science that did engage a popular tradition was that of natural history. The various series of natural history manuals, such as John Wood's *Common Objects of the Sea Shore*[707] were some of the best-selling popular science works of the nineteenth century and into the twentieth century. In Australia too, this tradition can be seen, and natural history columns could be found in several newspapers including the *Australasian*. However the social concerns enrolled by popular naturalists were significantly different from those of popular astronomy. Especially significant is that even though it was the central science in the debate over evolution and natural theology and the associated issues of religious authority, the religious sense was expressed far more weakly in the popular tradition of natural history than it was for astronomy. Instead, naturalists were largely concerned with aspects of place, invoking ideas of the countryside, and country living, implicitly or explicitly contrasted with urban dwelling. These schemata came in political versions that were both conservative—idealising country life, and promoting self-reliant, individualist and military virtues[708]—and progressive—concerned with improvement of urban conditions[709]—but centred around the same sets of debates, and thus addressed, in different ways, similar audiences.

The distinctiveness of the set of cultural schemata relating to astronomy thus has implications for how we understand popular science. Of course some cultural schemata did link the different sciences. By the end of the period of this study 'science' was popularly understood as a particular activity. The attitude linking science with the future, as described by James Secord at the head of this thesis, could be applied broadly to all of the practices that fell under the banner of science. Nonetheless it is important analytically to also appreciate the way in which each tradition of popular science was unique, rather than being a generic process of popularization applied to different scientific domains.

[707] Wood, *The Common Objects of the Sea Shore*, 1857.

[708] Griffiths, 'The Natural History of Melbourne', *Australian Historical Studies*, 1989, 339–65.

[709] Mirams, 'For Their Moral Health', *Australian Historical Studies*, 2002, 249–266.

6.3 The multiple timeframes of history

A primary motivation for the adoption of an interpretive framework of cultural schemata was to describe the multiple time frames involved in the operation of popular astronomy, the way in which new results would repeatedly be presented in terms of longstanding cultural resources, appreciating the durability of these resources without reifying them. Examples have been demonstrated throughout the thesis. One of the strongest of these in popular astronomy is the persistence of speculation about life on other planets.

The 'plurality of worlds' debate had deep roots in intellectual history and a broad appeal in popular culture. Certainly it remains a staple of interest in astronomy today. This question was also bound up with concerns about life, death, identity and religion. It was, after all, 'not strictly a matter for science'. However the precise implications of those concerns shifted, even as the overall shape of the debate remained roughly consistent. Particular theological questions and controversies associated with 'plurality of worlds' rose and fell through the eighteenth and nineteenth century. There are continuities and discontinuities at this time scale. For example, the implications of the question as perceived today—How unique are humans? What would be the appropriate geo-political response to alien contact?—are neither identical nor unrelated to those of the nineteenth century. The rapid timescale of scientific investigation impacted the popular debate on this question in the nineteenth century, as new facts in astronomy like the discovery of solar system objects, or advances in nebular theory were interpreted with respect to the habitability of these places. The plurality of worlds debate cannot be fully appreciated except with reference to all of these time scales.

An appreciation of the multiple timeframes of cultural history, and of cultural resources as learned and consciously deployed objects, draws attention to the interaction between personal life histories and the timescale of the development of cultural schemata. The prior understandings, experiences and expectations of audiences were crucial to the success of popularizers. The way that personal memories have helped shaped the social meanings of popular astronomy has been explored in a number of sections of this thesis, including the way that expectations of media technologies established in childhood contributed to their subsequent historical trajectory.

It was this ability to work with deep-rooted themes—or cultural schemata—that contributed to the success of popularizers like Richard Proctor, Camille Flammarion, William Whitehouse Collins and Clement Wragge. By contrast, presenters with more of a didactic, or variety entertainment style, like Professor Pepper fared less well. This engagement with schemata is clearly not the only characteristic of success—the major cultural schemata of astronomy, such as its history as an exemplary science, were used by far less skilful and successful popularizers than Proctor. The changing social and cultural bases for authority with respect to science was also a significant factor for individual popularizers, as was understanding, proficiency and management of the theatrical aspects of performance. However the observed responses clearly show that the best popularizations connected their scientific material with meanings held by the audience, and in most cases this was engaged through long-held cultural traditions.

6.4 The cultural schemata of popular astronomy in Australia

The cultural schema of astronomy unique to Australia was that of the country as being the land under the southern sky. In particular the Southern Cross rapidly became—and has persisted as—a symbol of Australia, as discussed in § 2.2. At various times, and for different people, this symbol has held different meanings—of connection with or difference from colonial power—but at all times an understanding of the southern skies contributed to the formation of Australian identity. The speed at which this symbolism transformed from an overt knowledge practice to an imagined one is particularly noteworthy. In the 1860s the vast majority of colonial Australians had experienced first-hand the slow appearance of the Southern Cross, the iconic asterism of the South. One generation later a majority of the Australian population had grown up under the southern skies. Yet the strength of the emotional relationship to the stars persisted through this rapid change in experience.

The role of the Southern Cross in identity formation is not the only cultural schema that developed in Australia. Attitudes to politics, religion and education all developed in particular ways in Australia and each of these was, to some extent, in response to attitudes to science in general and astronomy in particular. However I will focus this discussion of the cultural schema of Australia as a land under the stars on the Southern Cross.

Over the time period of this thesis, the Cross became the primary emblem of Australian identity. As they were throughout the century, children were being taught about the Southern Cross at the end of the nineteenth century, as illustrated in Figure 2.4, and for many this included the relationships with the colonial master. However, this relationship between Australia and Britain had undergone significant change throughout the nineteenth and indeed was changing rapidly at the dawning of the twentieth century. By the early part of the twentieth century, Britain was 'home' for many Australians in an abstract ideological sense, rather than the visceral sense in which Europe was 'home' for Ludwig Leichhardt.

The changing nature of this relationship and the fact that cultural schemata must not be interpreted as totalizing intellectual structures is shown by the cartoon in Figure 2.9, 'The New Southern Cross'. This was drawn by radical cartoonist Claude Marquet[710] as part of the anti-conscription campaign in 1916. The Southern Cross features in its standard form of representing Australian national identity, but in this image that is not a good thing. Marquet is here criticising a militaristic nationalism; the woman pictured turns away in horror from this vision of Australia. The preferred alternative is spelled out by other stars in the sky—a 'No' vote. The symbolism of the Southern Cross invokes both meanings that can be conjured up instantly, without conscious recognition, and ideas that can be explicitly considered and rejected. It is this dual character of cultural schemata that makes them powerful tools in communication, including popular astronomy.

The Southern Cross is, thus, more than a simple symbol. It invokes a complex set of meanings about identity and nationhood. Crucially, people can have different opinions about these meanings and yet find them mutually intelligible. The constellation is consciously perceived but can shape interpretations, is shared but not totalizing, and is capable of changing over time. The idea of Australia as a land under the southern sky thus meets the criteria established in Chapter 1 for a cultural schema.

Beyond this description of it, it is clear that this symbol played a part in identity formation, and by so doing allowed people, like the Eureka miners, to do things differently. In this way the lives of colonial Australians were made different through their understanding of the stars.

[710] Lindesay, 'Marquet, Claude Arthur (1869–1920)'.

6.5 Ways in which this study could be extended

The preceding sections of this chapter have outlined the major conclusions of this thesis. Necessarily, the scope of study has been limited. This section describes some of the ways in which those conclusions could be further developed—and tested—by additional research beyond those bounds.

This thesis has been bounded both temporally and thematically; tracing developments in popular astronomy across those bounds is the most obvious way of extending that study. An examination of the role of Mary Proctor and popular astronomy in the campaign to establish a solar observatory in Australia or New Zealand is one specific story that lies just outside the time period of this thesis. Following the threads of popularization through the twentieth and into the twenty-first century will not only test the analytical framework adopted by this thesis, it would also connect the historical study with contemporary concerns in science communication.

The thematic focus of this thesis has also created lacunae of content that can be filled in. Balancing the goals of Broks' dictum on one hand—looking for the scientific in what is popular—while maintaining a tight analytical gaze on a particular set of media practices on the other excluded a number of subjects. The history of astrology in this country is one that fell messily across this boundary, the history of unorthodox theories of astronomy another. A history of street astronomy in Australia also remains to be told.

Other subjects surveyed briefly by this thesis warrant a more detailed examination. Many aspects of the experience of the sky in colonial Australia remain to be elaborated. The way that the stars of the southern sky contributed to colonists' understanding of place was established in Chapter 2 but far more detailed accounts at an individual level can be given. More significantly, the interaction of colonial Australia with its deep Indigenous knowledge traditions is an important story that needs to be explored far more deeply than it has been.

The colonial relationship to Britain was clearly important in shaping knowledge practices in Australia, and it is this primary relationship that has been considered in this thesis. The analysis would be extended with a comparison of popular traditions in other contexts, including both other colonial circumstances and non-anglosphere traditions.

I noted in Chapter 4 the recent interest in work connecting lantern culture with early cinema. However there is more to be done here, and in particular a contribution made by examining how the scientific slides studied in this thesis developed the 'imaginary of old media' in the early twentieth century.

The conclusions of this thesis could only be enhanced with additional scrutiny from fresh angles. The distinctive set of cultural schemata associated with astronomy were explicated here, but while it is clear that different traditions of popularization did enrol different schemata, a direct comparison has not been made. Studying parallel activities in this way would be most illuminating. The advantages of comparative study have been suggested, but not yet delivered.

6.6 Conclusion

Popularization draws on meanings from both the culture of scientific research and from a wider popular culture. A study of popular science, such as in this these, can reveal how those two domains are connected, but also how they diverge. This thesis began with a claim that popular science is a strange beast. That animal is now slightly more familiar—but no more domesticated.

Astronomy in particular has long been regarded as having an important meaning for scientists and non-scientists alike science. This thesis has examined some of the ways in which this is manifested. In part it is because of the particular characteristics of astronomical observation. As has been remarked, the stars are a part of our daily lives and everyday experiences, yet they also present as remote, unreachable and untouchable. Astronomy sits between the quotidian and the divine.

It is, however, the cultural traditions that have developed over long timeframes of history that establish the meanings given to popular astronomy. The ability to both harness and shape these cultural schemata of astronomy largely defines successful popularization. Accordingly, a study of popularization needs to consider the multiple timescales associated with these schemata.

The cultural schemata analysed by this thesis—Australia is a land under the southern stars; astronomy tells of a sky that is a source of power and danger; astronomy gives us insight into religion; astronomy is an exemplary science; astronomy speaks to the human condition through the possibilities of life elsewhere; and the combination of several of these into the astronomical sublime—have all operated on longer scales of cultural history. They have all been used to interpret specific scientific discoveries for public audiences.

Popular astronomy is, as ‘The Size of Things in Australia’ (Figure 1.1) reminds us, just one ripple on the ocean of culture, but this thesis suggests that we can learn a lot more about that sea by watching how that ripple spreads out over time, interacting with others.

The stars we see are constantly with us, yet always out of reach. So too is popular astronomy motivated both by the concerns of the everyday as well as the unworldly. It is the interest implicit in this tension that gives power to the way people have understood the science of the stars.

7: Epilogue

This thesis is concluded. I have told stories and shown pictures. I will leave with some final reflections on the process.

This thesis began with some of my personal history. Indeed, the role between individual meaning-making and collective memories has been an underlying theme of this thesis. And now my history has both shaped and been shaped by the study.

What do I get from undertaking this? What is the purpose of historical study?
One reply comes quickly: these matters are interesting for their own sake. Yet that traditional answer is only partly satisfying. Everything matters, both the choices taken and those left behind.

Popular science is important. Many of the cultural schemata exhibited in this thesis are still in operation. They have deep roots, and we can learn some things about them by studying their pasts. But we well know that genealogy is not destiny. My vantage point, from which I scrutinize the subjects of my thesis, is in their unknown future. Inevitably my analytical gaze from there distorts. Is not a reflection of this gaze—to understand how our ideas are informed by their insights as understood by us—doubly distorting? Like the astronomers in the *Melbourne Punch* cartoon, (Figure 7.1) are we condemned to just ‘getting it out of the almanac’?

The most compelling reason for studying history for me is the expansion of possibilities it can give to the future. Popular astronomy *is* just one ripple on the sea of culture, but it all matters.

Today we can hear the echoes of Proctor from over a century, above a constantly churning noise. If we are quiet and listen carefully we can hear other rhythms too, older stories and from different places, near and far. The popular music of the spheres plays in many keys.

Source: Trove

Figure 7.1 ‘Proctor Settled’, 1880

This cartoon appeared in *Melbourne Punch* on 19 August 1880.

This joke is bittersweet for the historical analyst. We also attempt to explain the actions of our subjects from positions that have been shaped, at least in part, by those historical actors. Unless we can do a better job than Bill we too shall be condemned to “get it out of the almanacs”.

Bibliography

Primary Sources

Archival

Allport, Mary Morton, *Comet of 1843 Seen from Aldridge Lodge V.D. Land*, 1843, Allport Library and Museum of Fine Art, C8 DR10

Bingle, John, 'The Illustrated Retrospect of the Present Century', 1881, Mitchell Library, A128

Cameron, Mary Isabella, 'The Journal of Mary Isabella Cameron, 1847 on a Voyage from England to Tasmania on the Sailing Ship Tasmania', Australian National Maritime Museum, Vaughan Evans Library, MS TAS

Hellyer, Henry, 'Hellyer Journal - Illustrated Manuscript of "Voyage to Van Diemen"s Land, 1825' Original Manuscript', 1825, Tasmanian Archives and Heritage Office, NS433/1/2

Henry, Thomas Gibson., 'Journal Kept by Thomas Gibson Henry on Board the (?) En Route to Australia from Ireland in 1835', 1835, State Library of Victoria, MS BOX 3475/4

Ireland, Andrew, 'Letter to Bolton Stafford Bird' (Hobart, Tasmania), 1892, Tasmanian Archive and Heritage Office, TRE1/1/1224

Hentig, Elizabeth, 'Elizabeth Hentig Journal of a Voyage from London to Sydney in the Thomas Arbuthnot, 1853 Followed by an Account of the Return Voyage from Sydney to London in the Maha Ranee, 1864', 1853, Mitchell Library, MLMSS 7657

Morris, William Knibb, 'Letters, William Knibb Morris to Thomas John Morris, July 1877-1880', 1880, University of Tasmania Special & Rare Collections, Private Deposit M13/6

Riddell family, 'Papers, 1841-1924', 1841, State Library of Victoria, MS MC 3

Row, Elizabeth Barlow, 'Elizabeth Barlow Row Journal of Journey on Star of Peace from Sydney to England, 27 April-3 August 1858', 1858, Mitchell Library, MLMSS 2272

Synnot, Walter, *Sketch of a Comet*, 1843, Allport Library and Museum of Fine Art, C7 DR15

Todd, Charles, 'Letter Todd to Ellery, June 1880', 1880, PROV, VPRS 643/P0/Unit 173

(See also additional items in Tables and Figures including diaries listed in Table 2.1.)

Books, catalogues and pamphlets

A Theological Debate between Rev. John Hosking (United Methodist Free Church Minister) and W.W. Collins (Freethought Lecturer): Held at the Tuam Street Hall, Christchurch, New Zealand on December 15th, 16th, 17th and 18th, 1891 (Christchurch, New Zealand), 1892

Annual of Scientific Discovery; Or, Year-Book of Facts in Science and Art (Gould and Lincoln), 1856

Atkinson, James, *Epitome of the Art of Navigation: Or, a Short, Easy and Methodical Way to Become a Compleat Navigator* (W. & J. Mount), 1753

Babbage, Charles, *Passages from the Life of a Philosopher* (Longman, Green, Longman, Roberts, & Green), 1864

———, *The Ninth Bridgewater Treatise: A Fragment* (London: John Murray), 1838

Baracchi, Pietro, *The Stars on the Ensign of the Australian Commonwealth* (Brisbane: Sapsford & Company), 1902

Barff, Henry, *A Short Historical Account of the University of Sydney: In Connection with the Jubilee Celebrations 1852-1902* (Sydney, NSW: Angus and Robertson), 1902

Bickerton, A. W, *Romance of the Earth* (Christchurch, New Zealand: Bickerton), 1898

———, *The Evidence and Scope of the Theory of Impact* (Christchurch, New Zealand: Bickerton), 1905

———, *The Birth of Worlds and Systems*, Harper's Library of Living Thought (Harper & brothers), 1911

Bonwick, James, *Astronomy for Young Australians* (Thomas Harwood), 1864

Boswell, Annabella, *Annabella Boswell's Journal: An Account of Early Port Macquarie* (London; Sydney: Angus & Robertson), 1981

Brougham, Henry, *A Discourse of the Objects, Advantages, and Pleasures of Science*, Libr. of Useful Knowledge, 1827

Carpenter, W.B., *Popular Cyclopaedia of Natural Science. Mechanical Philosophy, Horology and Astronomy*, 1843

Clarke, Edward M., *List of Prices of Mathematical Philosophical, Optical, and Chemical Instruments and Apparatus Manufactured by Edward M. Clarke, Philosophical Instrument Maker* (Taylor and Walton), 1842

Clerke, Agnes, *A Popular History of Astronomy During the Nineteenth Century* (A. & C. Black), 1885

Cliffe, Edward, 'The Voyage of M. John Winter into the South Seas, by the Streight of Magellan', in *The World Encompassed by Sir Francis Drake*, Works Issued by the Hakluyt Society (Hakluyt Society), 1854, pp. 269–84

Collins, William Whitehouse, *The Church of Rome: The Enemy of Science and the Foe of Progress* (Sydney: Sydney Freethought Press), 1889

'Comet', *The Cyclopaedia, or Universal Dictionary of Arts, Sciences and Literature* (London: Longman, Hurst, Rees, Orme & Brown), 1819, 120–40

Collins, William Whitehouse, 'Biblical Chronology', *Liberator* (Melbourne, Victoria), 17 January 1886, p. 119

Darwin, Charles, *On the Origin of Species by Means of Natural Selection: Or the Preservation of Favoured Races in the Struggle for Life*, Classics of Medicine Library (Watts), 1859

———, *The Expression of the Emotions in Man and Animals* (London: John Murray), 1872

Denney, James, W.R. Nicoll, and J.A. Robertson, *Letters of Principal James Denney to W. Robertson Nicoll, 1893-1917* (BiblioBazaar), 2015

Dickens, Charles, *The Complete Works of Charles Dickens: The Uncommercial Traveller*, The Complete Works of Charles Dickens (Cosimo Classics), 2009

Doten, Lizzie, *Poems from the Inner Life* (Colby & Rich), 1863

Draper, John, *History of the Conflict Between Religion and Science*, Appletons' Scientific Library (D. Appleton), 1874

Easterley, Robert, and John Wilbraham, *The Germ Growers: An Australian Story of Adventure and Mystery* (Melbourne: Melville, Mullen & Slade), 1892

Egeson, Charles, *Egeson's Weather System of Sun-Spot Causality: Being Original Researches in Solar and Terrestrial Meteorology* (Sydney: Turner & Henderson), 1889

Flammarion, Camille, *Les Mondes Imaginaires et Les Mondes Réels: Voyage Pitoresques Dans Le Ciel* (Gauthier-Villars), 1876

———, *Omega: The Last Days of the World* (New York: Cosmopolitan Publishing Company), 1894

Frampton, John, *The Arte of Navigation*, Early English Books Online. (Imprinted at London: By Thomas Dawson, dwelling at the three Cranes in the Vinetree, and are these [sic] to be solde), 1595

Fraser, Joseph, *Melbourne and Mars: My Mysterious Life on Two Planets : Extracts from the Diary of a Melbourne Merchant* (Melbourne: Pater & Knapton), 1889

Harris, A., *Settlers and Convicts; Or, Recollections of Sixteen Years' Labour in the Australian Backwoods* (C. Cox), 1847

Herschel, John F. W., *A Treatise on Astronomy* (London: Longman, Brown, Green & Longmans), 1833

Herschel, William, 'Catalogue of 500 New Nebulae, Nebulous Stars, Planetary Nebulae, and Clusters of Stars; With Remarks on the Construction of the Heavens', *Philosophical Transactions of the Royal Society of London*, 92 (1802), 477–528 von Humboldt, Alexander, *Kosmos: A General Survey of Physical Phenomena of the Universe*, Kosmos: A General Survey of Physical Phenomena of the Universe, v. 1 (H. Baillière), 1845

Hutton, W., *The Book of Nature Laid Open, in a Popular Survey of the Phenomena and Constitution of the Universe*, (Georgetown: Joseph Milligan), 1821

Jones, W. & S., *A Catalogue of Optical, Mathematical, and Philosophical Instruments, Made and Sold by W. and S. Jones, No. 30, Lower Holborn, London*, 1822

———, *A Catalogue of Optical, Mathematical, and Philosophical Instruments, Made and Sold by W. and S. Jones, No. 30, Lower Holborn, London*, 1817

Keith, T., *A New Treatise on the Use of the Globes, Or a Philosophical View of the Earth and Heavens* (Longman, Rees, Orme, Brown and Green), 1828

Kelly, Joshua, *The Modern Navigator's Compleat Tutor: Or, A Treatise of the Whole Art of Navigation in Its Theory and Practice, &c.* (W. Mount & T. Page), 1733

Kirby, W., *On the Power, Wisdom and Goodness of God as Manifested in the Creation of Animals, and in Their History, Habits and Instincts*, Bridgewater Treatises (William Pickering), 1835

Laertius, D., and R.D. Hicks, *Lives of Eminent Philosophers*, Loeb Classical Library, v. 2 (Cambridge, Mass.: Harvard University Press), 1925

Lantern Slides Illustrating Zoology, Botany, Geology, Astronomy, Textiles &c., 4th edn (Manchester, UK: Flatters & Garnett), 1924

Leichhardt, Ludwig, *Journal of an Overland Expedition in Australia, from Moreton Bay to Port Essington* (T. & W. Boone), 1847

Meredith, Louisa Anne, *My Home in Tasmania: During a Residence of Nine Years* (London: John Murray), 1852

———, *Notes and Sketches of New South Wales: During a Residence in That Colony from 1839 to 1844* (London: John Murray), 1844

Marcet, Jane, *Conversations on Chemistry*, Conversations on Chemistry [by J. Marcet]. By Mrs. Marcet, 1853

New South Wales Registrar General's Office, *Census of the Colony of New South Wales, Taken on the 1st. March, 1856 under the Act of Council, 19 Victoria, No. 5* (Sydney: William Hanson, Govt. printer), 1857

Orr, Mary Ackworth, *Southern Stars: A Guide to the Constellations Visible in the Southern Hemisphere* (London: Gall and Inglis), 1896

Paley, William, *Natural Theology: Or, Evidence of the Existence and Attributes of the Deity* (London: R. Faulder), 1802

Pepper, John Henry, *The Boy's Playbook of Science: Including the Various Manipulations and Arrangements of Chemical and Philosophical Apparatus Required for the Successful Performance of Scientific Experiments*, (George Routledge and Sons), 1866

Proctor, Richard Anthony, ‘Letter from Richard A. Proctor to Reverend McDonnell, 11 September 1880’, 1880, Mitchell Library, Ap 38

Priestley, Joseph, *A Course of Lectures on Oratory and Criticism* (William Hallhead), 1781

Proctor, Richard Anthony, *Comets and Meteors*, R. A. Proctor’s Lectures, 4 (Sydney: M. A. Cleary), 1880

———, *Life in Other Worlds than Ours*, R. A. Proctor’s Lectures, 5 (Sydney: M. A. Cleary), 1880

———, *The Life and Death of a World*, R. A. Proctor’s Lectures, 1 (Sydney: M. A. Cleary), 1880

———, *The Moon*, R. A. Proctor’s Lectures, 3 (Sydney: M. A. Cleary), 1880

———, *The Sun*, R. A. Proctor’s Lectures, 2 (Sydney: M. A. Cleary), 1880

Romanes, George J., *Darwin and after Darwin. An Exposition of the Darwinian Theory and a Discussion of Post-Darwinian Questions* (Chicago: The Open court publishing company), 1892

———, ‘Recreation’, *Nineteenth Century*, September 1879, 401–24

Russell, Henry Chamberlain, *The Progress of Astronomical Photography : Address by the President of Section A, Astronomy, Mathematics, and Physics [of the Australasian Association for the Advancement of Science]*, 1893

Saxby, S.M., *Saxby’s Weather System: Or, Lunar Influence on Weather* (Longman, Green), 1864

Sturmy, Samuel, *The Mariner’s Magazine: Or, Sturmy’s Mathematical and Practical Arts* (E. Cotes), 1669

Tebbutt, John, *The Testimony Which Astronomy Furnishes to the Attributes of the Creator* (Sydney: Foster and Fairfax), 1878

Trollope, Anthony, *Australia and New Zealand*, Authorised (Melbourne: G. Robertson), 1873

Twopeny, Richard, *Town Life in Australia* (E. Stock), 1883

Tyndall, John, *Fragments of Science for Unscientific People: A Series of Detached Essays, Lectures, and Reviews* (D. Appleton), 1871

———, *Six Lectures on Light: Delivered in America in 1872-1873* (Longmans, Green), 1873

Verne, Jules, *Off on a Comet: Or, Hector Servadac* (Floating Press), 2009

Whewell, William, *Astronomy and General Physics Considered with Reference to Natural Theology*, Bridgewater Treatises on the Power Wisdom and Goodness of God as Manifested in the Creation (Pickering), 1833

White, Andrew Dickerson, *A History of the Warfare of Science with Theology in Christendom*, A History of the Warfare of Science with Theology in Christendom, v. 1 (D. Appleton), 1896

Wood, John, *The Common Objects of the Sea Shore: Including Hints for an Aquarium* (G.Routledge & Company), 1857

Newspapers, magazines and journals

A Distant Observer, 'Mr. Proctor's Lectures', *South Australian Advertiser* (Adelaide, SA), 21 July 1880, p. 10

'A Great Entertainer', *Evening Journal* (Adelaide, SA), 11 September 1896, p. 2

'A Lady Astronomer', *Advertiser* (Adelaide, SA), 24 September 1912, p. 9

A Lover of Research, 'Original Correspondence. School of Arts', *Sydney Herald* (Sydney, NSW), 27 October 1834, p. 3

'A Pestilential Period. The Perihelia of the Planets and Their Influence Upon Health', *Queenslander* (Brisbane, Queensland), 1 February 1879, p. 148

'A Scientist's Romance', *Sacramento Daily Record-Union* (Sacramento, Ca.), 16 April 1881, p. 1

'A Woman's Warning', *Australasian* (Melbourne, Victoria), 22 December 1900, p. 35

Abbott, Francis, 'On the Variability of Eta Argus and Surrounding Nebulae', *Monthly Notices of the Royal Astronomical Society*, 28 (1868), 200–202

'Advance Australia', *Sydney Gazette and New South Wales Advertiser* (Sydney, NSW), 15 October 1831, p. 2

———, *Sydney Gazette and New South Wales Advertiser* (Sydney, NSW), 20 December 1834, p. 2

'Advertising', *Sydney Morning Herald* (Sydney, NSW), 27 April 1869, p. 6

———, *Colonial Times* (Hobart, Tasmania), 8 August 1843, p. 1

———, *Sydney Morning Herald* (Sydney, NSW), 11 November 1852, p. 4

———, *Launceston Examiner* (Launceston, Tasmania), 22 January 1848, p. 7

———, *Sydney Morning Herald* (Sydney, NSW), 18 November 1862, p. 1

———, *Evening Journal* (Adelaide, SA), 19 May 1886, section SECOND EDITION, p. 1

'Advertising. Astronomical Lectures at the Royal Hotel', *Sydney Morning Herald* (Sydney, NSW), 31 December 1842, p. 3

'Advertising. Lecture on Astronomy', *South Bourke Standard* (Melbourne, Victoria), 5 December 1862, p. 1

'Advertising. Royal Polytechnic', *Empire* (Sydney, NSW), 15 June 1854, p. 1

'Advertising. Royal Polytechnic Exhibition', *Sydney Morning Herald* (Sydney, NSW), 20 February 1854, p. 2

'Advertising. Stereoscopes', *Sydney Morning Herald* (Sydney, NSW), 5 November 1853, p. 8

'Almanacs', *Examiner* (Kiama, NSW), 8 January 1861, p. 2

‘Amusements’, *Otago Daily Times* (Dunedin, New Zealand), 21 October 1880, p. 1

———, *Register* (Adelaide, SA), 4 November 1901, p. 6

‘An Austrian Row’, *Daily News* (Perth, WA), 22 October 1897, p. 3

‘An Editor and the “Much Travelled”’ (Adelaide, SA), 6 October 1914, p. 5

‘An English Leader’, *Worker* (Brisbane, Queensland), 26 August 1899, p. 2

‘An Interesting Career’, *New York Times* (New York, NY), 9 September 1894, p. 18

Andrade, William Charles, ‘Freethought in Melbourne’, *The Freethought Review*, 1 April 1884, 8

———, ‘Our Illustration’, *Liberator* (Melbourne, Victoria), 10 January 1886, p. 102

‘Annual Exhibition: Paddington Public School’, *Evening News* (Sydney, NSW), 14 December 1871, p. 2

‘Are There Other Worlds Habitable by Man?’, *Brisbane Courier* (Brisbane, Queensland), 10 July 1902, p. 8

‘Astronomical Chat’, *Bendigo Advertiser* (Bendigo, Victoria), 9 June 1886, section Supplement to The Bendigo Advertiser, p. 1

‘Astronomical Illustrations’, *The Magazine of Science and School of Arts*, 4 April 1840, 1–3

‘Astronomical Lecture’, *Balmain Observer and Western Suburbs Advertiser* (Sydney, NSW), 5 May 1888, p. 5

‘Astronomical Lectures’, *Bathurst Free Press and Mining Journal* (Bathurst, NSW), 3 July 1861, p. 4

‘Astronomical Notes for March’, *Launceston Examiner* (Launceston, Tasmania), 13 March 1844, p. 3

‘Astronomical Notices’, *Australian Town and Country Journal* (Sydney, NSW), 7 April 1877, p. 18

‘Astronomical Photography’, *Advertiser* (Adelaide, SA), 23 July 1901, p. 6

‘Astronomy and the Jewish Festival’, *Jewish Herald* (Melbourne, Victoria), 17 December 1880, pp. 6–7

‘Australasian Courts. Victoria’, *Weekly Times* (Melbourne, Victoria), 4 August 1888, section Weekly Times Exhibition Supplement, p. 12

Australian, ‘The New South Wales Ensign’, *Sydney Morning Herald* (Sydney, NSW), 26 May 1908

‘Barcaldine’, *Capricornian* (Rockhampton, Queensland), 31 January 1891, p. 28

Barkas, W. J., ‘Popular Lectures On a Human Tooth, Its Growth Structure and Uses’, *Australian Town and Country Journal* (Sydney, NSW), 26 August 1876, p. 18

Benvie, J, ‘A Few Thoughts on Current Speculations’, *Maitland Mercury and Hunter River General Advertiser* (Maitland, NSW), 11 September 1880, p. 7

Berkeley, George, ‘(No Title)’, *Guardian* (London, UK), 1 June 1713

Buchanan, David, ‘Mr Proctor’s Sunday Lecture’, *Sydney Morning Herald* (Sydney, NSW), 14 September 1880, p. 6

‘Charge of Creating a Nuisance’, *Argus* (Melbourne, Victoria), 23 August 1887, p. 5

‘Classified Advertising’, *Brisbane Courier* (Brisbane, Queensland), 25 September 1869, p. 1

‘Colonial Art’, *Bell’s Life in Sydney and Sporting Chronicle* (Sydney, NSW), 9 October 1869, p. 3

‘Comets in Australia’, *Australian Town and Country Journal* (Sydney, NSW), 21 February 1880, p. 25

‘Commonwealth Weather Chart’, *Australian Town and Country Journal* (Sydney, NSW), 17 October 1906, p. 13

‘Concluding Lecture on Astronomy – The Astral Heavens’, *Port Philip Gazette* (Melbourne, Victoria), 13 December 1847, p. 1

‘Current Topics’, *Launceston Examiner* (Launceston, Tasmania), 6 June 1891, p. 2

———, *Geelong Advertiser* (Geelong, Victoria), 26 January 1863, p. 2

‘Death of Mr. R. S. Smythe’, *Argus* (Melbourne, Victoria), 24 May 1917, p. 6

‘Debate’, *Woodville Examiner* (Woodville, New Zealand), 18 February 1895, p. 2

Denison, William, ‘Observatory’, *Sydney Morning Herald* (Sydney, NSW), 28 June 1855, p. 2

‘Dioastrodoxon or the Heavens Displayed’, *Colonial Times* (Hobart, Tasmania), 29 August 1837, p. 2

‘Display Advertising’, *Courier* (Hobart, Tasmania), 13 November 1847, p. 3

‘Dissolving Views’, *Freemans’ Journal* (Sydney, NSW), 24 September 1853, p. 10

Dittmann, Gustavus, ‘On the Southern Cross’, *The Nautical Magazine*, April 1836, 214–25

‘Divine Power as Seen in the Phenomena of Life’, *Adelaide Observer* (Adelaide, SA), 17 March 1849, section Supplement to the ‘Adelaide Observer.’, p. 2

‘Domestic Intelligence. Mechanics’ Institution’, *Melbourne Argus* (Melbourne, Victoria), 8 January 1847, p. 2

‘Domestic Intelligence. Mr Ellery’s Lecture’, *Williamstown Chronicle* (Melbourne, Victoria), 20 June 1857, p. 3

‘Dr. Hosking and the Wesleyans’, *New Zealand Herald* (Auckland, New Zealand), 28 February 1900, p. 6

‘Dr. Udny’s Lecture’, *Cornwall Chronicle* (Launceston, Tasmania), 10 June 1843, p. 2

‘Eclipse of the Sun’, *Sydney Morning Herald* (Sydney, NSW), 30 January 1851, p. 2

Eglinton, Dudley, ‘Astronomy. Astronomical Notes for March’, *Queenslander* (Brisbane, Queensland), 3 March 1900, p. 430

Ellery, Robert J, ‘Time’, *Argus* (Melbourne, Victoria), 7 May 1853, p. 9

Enquirer, ‘Teetotal Advocacy’, *Bunyip* (Gawler, SA), 10 September 1880, p. 3

‘Equity Jurisdiction’, *Mercury* (Hobart, Tasmania), 2 May 1896, section The Mercury Supplement., p. 1

‘Evolution and Religion’, *Australian Town and Country Journal* (Sydney, NSW), 24 April 1880, p. 27

‘Extraordinary Shooting Occurrence’, *Age* (Melbourne, Victoria), 27 June 1890, p. 5

‘Fear of The Comet’, *Wagga Wagga Advertiser* (Wagga Waga, NSW), 24 May 1910, p. 2

Figaro, ‘In the Barber’s Shop’, *Telegraph, St Kilda, Prahran and South Yarra Guardian* (Melbourne, Victoria), 17 April 1880, p. 3

‘Finding TIme by the Sun’, *Education Gazette and Teachers’ Aid*, 20 February 1905, pp. 123–24

‘Flag of the Australasian League’, *Launceston Examiner* (Launceston, Tasmania), 6 October 1852, p. 5

‘Fugitive Notes’, *Sydney Morning Herald* (Sydney, NSW), 19 December 1891, p. 5

‘Gaiety Theatre’, *Sydney Morning Herald* (Sydney, NSW), 20 March 1893, p. 9

‘Galileo, Professor Proctor, and the Papacy’, *Protestant Standard* (Sydney, NSW), 23 March 1889, p. 9

‘Gawler Town’, *Adelaide Observer* (Adelaide, SA), 11 September 1858, p. 4

‘Glenburn September 20’, *South Australian Chronicle and Weekly Mail* (Adelaide, SA), 24 September 1870, p. 7

‘Gorillas at the National Museum’, *Argus* (Melbourne, Victoria), 20 June 1865

‘Goulburn’, *Sydney Morning Herald* (Sydney, NSW), 14 February 1851, p. 2

‘Halley’s Comet. Weird Scenes in America’, *Telegraph* (Brisbane, Queensland), 4 July 1910, p. 2

Halloran, Laurence Hynes, ‘Public Lectures’, *Australian* (Sydney, NSW), 30 July 1830, p. 2

Ham, Alice, ‘The Occultation of Venus as I Saw It’, *Centennial Magazine*, December 1888, 316–17

Henry, Thomas, ‘An Hour with the Astronomers’, *Sydney Quarterly Magazine*, 137–42

Herschel, John F. W., ‘On the Variable Star Eta Argus and Its Surrounding Nebula’, *Monthly Notices of the Royal Astronomical Society*, 28 (1868), 225–29

Hirst, George Denton, 'New South Wales and the Transit of Venus of 1874', *Sydney Morning Herald* (Sydney, NSW), 17 April 1875, p. 10

von Humboldt, Alexander, 'Personal Narrative of Travels to the Equinoctial Regions of the New Continent during the Years 1799-1804', *The Edinburgh Review, or Critical Journal*, June 1815, 86–111

———, 'Personal Narrative of Travels to the Equinoctial Regions of the New Continent during the Years 1799-1804', *Quarterly Review*, January 1816, 368–402

'Influence of the Moon on Rainfall', *Sydney Mail and New South Wales Advertiser* (Sydney, NSW), 21 September 1901, p. 728

Ingemann, H., 'In the Sea of Science. Composition of the Heavenly Bodies - Meteorites', *Worker* (Brisbane, Queensland), 14 April 1900, p. 2

———, 'In the Sea of Science. The Stellar World', *Worker* (Brisbane, Queensland), 31 March 1900, p. 2

———, 'In the Sea of Science. The Stellar World', *Worker* (Brisbane, Queensland), 7 April 1900, p. 2

———, 'Science and Knowledge', *Worker* (Brisbane, Queensland), 24 March 1900, p. 2

'Insolvency Business', *Australasian Chronicle* (Sydney, NSW), 2 August 1843, p. 3

'Insolvency Court', *Sydney Mail and New South Wales Advertiser* (Sydney, NSW), 13 June 1874, p. 762

'It Can't Be Done', *Spectator* (London, UK), 29 August 1846, p. 830

Jefferis, James, 'Astronomy and Theology', *Sydney Morning Herald* (Sydney, NSW), 2 September 1880, p. 6

———, 'Astronomy and Theology', *Sydney Morning Herald* (Sydney, NSW), 4 September 1880, p. 3

'Kilmore', *Geelong Advertiser* (Geelong, Victoria), 6 February 1851, p. 2

'Ladies Letter from Paris', *Telegraph* (Brisbane, Queensland), 9 November 1892, p. 2

'Langer's Weather Almanac', *Newcastle Morning Herald and Miners' Advocate* (Newcastle, NSW), 4 December 1886, p. 6

'Latest Intelligence', *Bendigo Advertiser* (Bendigo, Victoria), 12 July 1880, p. 2

'Lecture at the Institute', *South Australian Advertiser* (Adelaide, SA), 28 December 1861, p. 3

'Lecture by Mr Collins', *Evening Star* (Dunedin, New Zealand), 17 August 1893, p. 2

'Lecture on Astronomy', *Rockhampton Bulletin* (Rockhampton, Queensland), 25 July 1872, p. 2

'Lecture on Astronomy at the School of Arts, St. Leonards', *Empire* (Sydney, NSW), 26 June 1860, p. 5

‘Lecture on Popular Astronomy’, *Age* (Melbourne, Victoria), 19 July 1856, p. 2

‘Lectures’, *Newcastle Morning Herald* (Newcastle, NSW), 10 September 1880, p. 1

———, *Press* (Christchurch, New Zealand), 17 June 1893, p. 1

‘Legislative Assembly’, *Evening News* (Sydney, NSW), 23 June 1880, p. 3

‘Literature. Pleasant Ways in Science’, *Australasian* (Melbourne, Victoria), 22 February 1879, p. 8

‘Literature. Review’, *Australian Town and Country Journal* (Sydney, NSW), 15 April 1876, p. 24

‘Local’, *Cornwall Chronicle* (Launceston, Tasmania), 24 December 1851, p. 817

‘Local and General News’, *Newcastle Morning Herald and Miners’ Advocate* (Newcastle, NSW), 4 May 1886, p. 5

‘Local and General News. Almanac’, *Northern Star* (Lismore, NSW), 27 December 1879, p. 2

‘Local Intelligence’, *Hobarton Guardian, Or, True Friend of Tasmania* (Hobart, Tasmania), 5 February 1851, p. 3

‘Local Intelligence. Mechanics’ Institute’, *Colonial Times* (Hobart, Tasmania), 27 May 1854, p. 3

‘Local News’, *Singleton Argus* (Singleton, NSW), 3 January 1894, p. 2

———, *Australian* (Sydney, NSW), 10 November 1838, p. 3

Macdonnell, W. J., ‘New South Wales and the Transit of Venus of 1874’, *Sydney Morning Herald* (Sydney, NSW), 17 April 1875, p. 10

Mackay, Charles, ‘A Discourse on Poetry and on the Duties of the Poet’, *The People’s Journal*, 1847, 108–12

‘Man’s Place in Nature’, *Age* (Melbourne, Victoria), 17 July 1863

‘Mechanics’ Institute’, *Launceston Examiner* (Launceston, Tasmania), 6 September 1845, p. 3

———, *Launceston Examiner* (Launceston, Tasmania), 10 May 1845, p. 5

———, *Launceston Examiner* (Launceston, Tasmania), 21 September 1844, p. 4

‘Mechanics’ Institute Lectures on Astronomy’, *Courier* (Hobart, Tasmania), 30 September 1854, pp. 2–3

‘Mechanics’ Institute. The Rev C Price’s Lecture’, *Cornwall Chronicle* (Launceston, Tasmania), 10 May 1845, p. 2

‘Mechanics’ Institution’, *Hobart Town Courier* (Hobart, Tasmania), 28 November 1829, p. 4

———, *Port Philip Gazette* (Melbourne, Victoria), 8 September 1841, p. 4

‘Melbourne Mechanics’ Institution’, *Age* (Melbourne, Victoria), 31 January 1856, p. 3

‘Melbourne, Saturday, 18th July, 1863’, *Age* (Melbourne, Victoria), 18 July 1863

‘Melbourne Theatricals’, *Launceston Examiner* (Launceston, Tasmania), 19 April 1880, p. 3

‘Miss Mary Proctor’, *Sydney Stock and Station Journal* (Sydney, NSW), 12 July 1912, p. 2

Morris, A., ‘The Transit of Venus’, *Sydney Morning Herald* (Sydney, NSW), 14 April 1875, p. 9

‘Mr C. L. Wragge’s Farewell Lecture’, *Queensland Times, Ipswich Herald and General Advertiser* (Ipswich, Queensland), 12 June 1902, p. 7

‘Mr. Egeson Again’, *Evening Journal* (Adelaide, SA), 4 February 1891, p. 3

‘Mr. Egeson’s Late Position at the Observatory’, *Sydney Morning Herald* (Sydney, NSW), 29 November 1890, p. 5

‘Mr. Egeson’s Predictions’, *National Advocate* (Bathurst, NSW), 11 March 1890, p. 3

‘Mr Egeson’s Prophecy’, *Freeman’s Journal* (Sydney, NSW), 15 March 1890, p. 7

‘Mr. Egeson’s Weather Forecast. The Official Correspondence’, *Sydney Morning Herald* (Sydney, NSW), 24 October 1889, p. 4

‘Mr. Egeson’s Weather Predictions’, *Sydney Mail and New South Wales Advertiser* (Sydney, NSW), 19 October 1889, p. 854

‘Mr Frank T. Bullen’, *Bendigo Advertiser* (Bendigo, Victoria), 28 March 1906, p. 6

‘Mr Proctor the Astronomer’, *New Zealand Herald* (Auckland, New Zealand), December 1880, p. 6

‘Mr Proctor’s Astronomical Lectures’, *South Australian Register* (Adelaide, SA), 10 July 1880

‘Mr. Proctor’s Astronomical Lectures’, *Argus* (Melbourne, Victoria), 28 May 1880, p. 6

———, *Sydney Morning Herald* (Sydney, NSW), 30 August 1880, p. 6

‘Mr Proctor’s Lecture on the Moon’, *South Australian Register* (Adelaide, SA), 21 July 1880, p. 6

‘Mr. Richard Anthony Proctor’, *Argus* (Melbourne, Victoria), 24 May 1880, p. 7

‘Much Ado About Nothing’, *Protestant Standard* (Sydney, NSW), 8 February 1890, p. 3

‘Municipal Corporations. Correspondence’, *South Australian Register* (Adelaide, SA), 9 October 1872, p. 3

‘Musical Memories’, *Daily Mail* (Brisbane, Queensland), 4 October 1925, p. 10

‘New Advertisements’, *Marlborough Express* (Marlborough, New Zealand), 23 November 1880, p. 3

‘New Colonial Flag’, *South Australian Register* (Adelaide, SA), 22 May 1851, p. 3

‘New South Wales’, *Argus* (Melbourne, Victoria), 24 July 1884, p. 7

‘New Telescopes’, *Launceston Examiner* (Launceston, Tasmania), 3 April 1897, p. 14

‘News and Notes’, *Dawn* (Sydney, NSW), 5 October 1889, p. 13

‘News from the Sun’, *Brisbane Courier* (Brisbane, Queensland), 6 September 1882, p. 2

‘News in England on the Observations of the Transit of Venus’, *Australian Town and Country Journal* (Sydney, NSW), 13 February 1875, p. 27

‘News of the Day’, *Sydney Morning Herald* (Sydney, NSW), 11 September 1884, p. 9

———, *Age* (Melbourne, Victoria), 29 June 1880, p. 2

———, *Sydney Morning Herald* (Sydney, NSW), 20 August 1886, p. 7

———, *Age* (Melbourne, Victoria), 5 November 1881, p. 4

‘News of the Week’, *Leader* (Melbourne, Victoria), 3 February 1866, p. 2

———, *South Australian Chronicle and Weekly Mail* (Adelaide, SA), 15 January 1881, p. 7

‘(No Title)’, *Evening News* (Sydney, NSW), 12 August 1872, p. 2

———, *Sydney Morning Herald* (Sydney, NSW), 27 March 1857, p. 4

———, *Brisbane Courier* (Brisbane, Queensland), 22 April 1871, p. 4

———, *Otago Daily Times* (Dunedin, New Zealand), 7 December 1880, p. 2

———, *Thames Advertiser* (Thames, New Zealand), 19 January 1881, p. 2

———, *Wairarapa Daily Herald* (Masterton, New Zealand), November 1880, p. 2

———, *Argus* (Melbourne, Victoria), April 1880, p. 5

———, *Sydney Morning Herald* (Sydney, NSW), 13 September 1880, p. 4

———, *Era* (London, UK), 23 May 1856

———, *Argus* (Melbourne, Victoria), 20 July 1863

———, *Sydney Morning Herald* (Sydney, NSW), 16 April 1889, p. 7

———, *Sydney Morning Herald* (Sydney, NSW), 19 November 1889, p. 7

———, *Empire* (Sydney, NSW), 19 August 1859, p. 4

———, *Argus* (Melbourne, Victoria), 21 October 1870, p. 5

‘Obituary’, *Australian Town and Country Journal* (Sydney, NSW), 6 January 1904, p. 55

‘Observatory’, *Sydney Morning Herald* (Sydney, NSW), 20 February 1851, p. 2

Œdipus, ‘Science. Scientific Gossip’, *Leader* (Melbourne, Victoria), 11 December 1869, p. 5

‘Opening Northern Railways on Sundays’, *South Australian Register* (Adelaide, SA), 2 May 1881, p. 6

‘Opening of the Congregational Church, College Park’, *South Australian Register* (Adelaide, SA), 14 June 1880, p. 6

‘Opening of the Polytechnic Institute’, *Leader* (Melbourne, Victoria), 27 December 1862, p. 12

‘Other Worlds’, *West Gippsland Gazette* (Warragul, Victoria), 7 November 1899, p. 3

‘Other Worlds than Ours’, *Southland Times* (Invercargill, New Zealand), 15 November 1910, p. 5

‘Our Buildings’, *Journal of Australasia*, August 1856, 49–52

‘Our City Letter’, *Kapunda Herald* (Kapunda, SA), 13 July 1880, p. 3

‘Our London Letter’, *Argus* (Melbourne, Victoria), 21 February 1910, p. 8

P. G. K., ‘Transit of Venus’, *Sydney Morning Herald* (Sydney, NSW), 2 February 1875, p. 6

‘Parkes and Proctor’, *Freeman’s Journal* (Sydney, NSW), 11 September 1880, p. 13

‘Parramatta’, *Sydney Morning Herald* (Sydney, NSW), 28 March 1857, p. 5

‘Peters’ Comet’, *Darling Downs Gazette and General Advertiser* (Toowoomba, Queensland), 25 March 1865, p. 3

‘Photography’, *Australian Town and Country Journal* (Sydney, NSW), 13 November 1886, p. 33

Picton, H. G., ‘Review of the Selby v Collins Debate’, *Protestant Standard* (Sydney, NSW), 11 May 1889, p. 7

‘Picture-Minded. Magic Lantern Come-Back’, *Methodist* (Sydney, NSW), 18 April 1936, p. 4

‘Police Court - Port Adelaide’, *South Australian Advertiser* (Adelaide, SA), 7 January 1881, p. 3

‘Political Pellets’, *Worker* (Brisbane, Queensland), 2 March 1895, p. 3

‘Popular Astronomy’, *Argus* (Melbourne, Victoria), 19 June 1884, p. 6

‘Presidential Address’, *Journal and Proceedings of the Royal Society of New South Wales*, 38 (1904), 1–20

Proctor, Richard Anthony, ‘Astronomy and Religion’, *South Australian Chronicle and Weekly Mail* (Adelaide, SA), 7 August 1880, p. 4

———, ‘Mr Proctor’s Farewell’, *Argus* (Melbourne, Victoria), January 1881, p. 7

———, ‘Mr. Proctor’s Lectures’, *Argus* (Melbourne, Victoria), 12 June 1880, p. 8

———, ‘(No Title)’, *Knowledge: A Monthly Record of Science*, 1 (1882)

———, ‘Note on Mr. Abbott’s Imagined Discovery of Great Changes in the Argo Nebula’, *Monthly Notices of the Royal Astronomical Society*, 32 (1871), 62–64

———, ‘Scientific. Lands and Seas of Another World’, *Australasian* (Melbourne, Victoria), 31 October 1868, pp. 6–7

———, ‘Scientific. Planetary Suns’, *Australasian* (Melbourne, Victoria), 27 July 1872, p. 6

———, ‘Scientific. Popular Science’, *Australasian* (Melbourne, Victoria), 16 August 1879, p. 8

———, ‘Scientific. Popular Science’, *Australasian* (Melbourne, Victoria), 30 August 1879, p. 8

———, ‘Scientific. Popular Science’, *Australasian* (Melbourne, Victoria), 20 September 1879, p. 6

———, ‘Scientific. Popular Science’, *Australasian* (Melbourne, Victoria), 6 March 1880, p. 7

———, ‘Scientific. Popular Science’, *Australasian* (Melbourne, Victoria), 28 February 1880, p. 7

———, ‘Scientific. Popular Science’, *Australasian* (Melbourne, Victoria), 5 June 1880, p. 8

———, ‘Scientific. The Asteroids and Their Lessons’, *Australasian* (Melbourne, Victoria), 13 April 1878, p. 7

———, ‘Suns in Flames’, *Belgravia*, March 1877, 32–52

———, ‘The Great Nebula in Argo’, *Fraser’s Magazine*, December 1868, pp. 762–68

———, ‘The Sun and the Comet’, *Mercury* (Hobart, Tasmania), 11 January 1883, p. 3

‘Proctor’s Paradoxes’, *Recorder* (Port Pirie, SA), 7 June 1922, p. 4

‘Prof. Proctor in Boston’, *New York Tribune* (New York, NY), 8 November 1875, p. 1

‘Professor Denton’s Lectures’, *Bendigo Advertiser* (Bendigo, Victoria), 28 September 1881, p. 3

‘Professor Pepper’, *Argus* (Melbourne, Victoria), 1 July 1879, pp. 5–6

———, *Argus* (Melbourne, Victoria), 12 July 1879, p. 8

‘Professors Huxley and Halford’, *Argus* (Melbourne, Victoria), 4 February 1864

‘Progress of Astronomy - Mr Ellery’s Lecture’, *Leader* (Melbourne, Victoria), 30 July 1870, p. 12

‘Prominent Topics. Doing Justice’, *Advocate* (Melbourne, Victoria), 12 April 1879, p. 10

‘Proposed Astronomical Society’, *Brisbane Courier* (Brisbane, Queensland), 13 May 1896, p. 4

‘Provincial Telegrams’, *Evening Journal* (Adelaide, SA), 30 July 1880, p. 2

‘Religious’, *Queenslander* (Brisbane, Queensland), 16 March 1895, p. 493

‘Review - The Stars and the Earth; Or Thoughts upon Space, Time and Eternity’, *Sydney Morning Herald* (Sydney, NSW), 14 February 1860

‘Richard Anthony Proctor’, *South Australian Advertiser* (Adelaide, SA), 9 July 1880, p. 6

‘Richmond Minstrel Club’, *Windsor and Richmond Gazette* (Windsor, NSW), June 1896, p. 6

‘Richter’s Dream of the Universe’, *Western Star and Roma Advertiser* (Toowoomba, Queensland), 22 September 1880, p. 3

‘Rival Astronomers’, *Evening News* (Sydney, NSW), 31 October 1890, p. 6

‘Royal Polytechnic’, *Sydney Morning Herald* (Sydney, NSW), 3 February 1855, p. 5

‘Royal Society. Astronomical Observations and Instruments’, *Sydney Mail and New South Wales Advertiser* (Sydney, NSW), 13 November 1875, p. 6

‘Royal Society of Victoria’, *Argus* (Melbourne, Victoria), 14 June 1870, p. 6

Russell, Henry Chamberlain, ‘A Startling Astronomical Discovery’, *The Observatory*, 3 (1879), 178–80

———, ‘Comet B, 1881’, *Sydney Morning Herald* (Sydney, NSW), 11 October 1881, p. 3

———, ‘The Transit of Venus’, *Sydney Morning Herald* (Sydney, NSW), 18 January 1875, p. 3

Sanders, H. Armytage, ‘The Decline of Lantern Views’, *The Optical Magic Lantern Journal and Photographic Enlarger*, April 1900, 48

‘Saxby’s Weather System’, *Age* (Melbourne, Victoria), 1 November 1864, p. 6

‘School of Mines Popular Science Lectures’, *Ballarat Star* (Ballarat, Victoria), 6 July 1882, p. 4

‘Science in State Schools’, *Age* (Melbourne, Victoria), 9 August 1879, p. 6

‘Scientific’, *Week* (Brisbane, Queensland), 22 March 1894, p. 30

———, *South Australian Chronicle* (Adelaide, SA), 24 July 1880, p. 15

———, *Ballarat Courier* (Ballarat, Victoria), 18 August 1874, p. 3

———, *Adelaide Observer* (Adelaide, SA), 18 January 1890, p. 41

‘Scientific & Useful’, *Queenslander* (Brisbane, Queensland), 12 May 1894

‘Scientific, and Useful. Kernels’, *Australian Town and Country Journal* (Sydney, NSW), 28 June 1890, p. 27

‘Scientific and Useful. The Transit of Venus’, *Queenslander* (Brisbane, Queensland), 14 November 1874, p. 6

‘Scientific Lectures’, *Coolgardie Mine* (Coolgardie, WA), 17 June 1902, p. 2

‘Scientific Memoranda’, *Bathurst Advocate* (Bathurst, NSW), 10 March 1849, p. 4

‘Scientific. The Dog Star and His System’, *Australasian* (Melbourne, Victoria), 3 June 1876, p. 6

Severn, Henry A., ‘The Great Melbourne Telescope’, *Argus* (Melbourne, Victoria), 24 February 1870, p. 7

‘Sidney Bigotry’, *Echo* (Dunedin, New Zealand), 2 October 1880, p. 2

‘Singular Appearance in the Heavens’, *Sydney Gazette* (Sydney, NSW), 9 April 1833, p. 2

‘Social Notes’, *Australasian* (Melbourne, Victoria), 4 June 1892, p. 38

‘South Australia’, *Australian Town and Country Journal* (Sydney, NSW), 19 December 1885

‘Spencer’s Royal Polytechnic’, *Illustrated Sydney News and New South Wales Agriculturalist and Grazier* (Sydney, NSW), 21 December 1872, p. 2

‘Spirit of Discovery. New South Wales’, *The Mirror of Literature, Amusement, and Instruction*, 5 July 1834, pp. 69–72

‘Statement by Miss Proctor’, *Daily News* (Perth, WA), 31 July 1913, p. 3

‘Stoppage of Mr Proctor’s Sunday Lecture’, *Sydney Morning Herald* (Sydney, NSW), 6 September 1880, p. 6

‘Summary for Europe’, *Argus* (Melbourne, Victoria), 7 November 1872, section The Argus Supplement, p. 1

‘Supreme Court’, *Sydney Gazette and New South Wales Advertiser* (Sydney, NSW), 9 July 1839, p. 2

‘Supreme Court. Criminal Sessions. Thursday, 22nd February, 1855. The State Trials’, *Argus* (Melbourne, Victoria), 24 February 1855, p. 5

‘Sydney Freethought Hall’, *Sydney Morning Herald* (Sydney, NSW), 27 January 1890, p. 3

‘Sydney Mechanics’ School of Arts’, *Sydney Monitor* (Sydney, NSW), 15 November 1834, p. 3

‘Sydney Mechanics School of Arts’, *Sydney Monitor* (Sydney, NSW), 7 February 1835, p. 2

Symes, Joseph, ‘The Solar System and Its Boasted Perfections’, *Liberator* (Melbourne, Victoria), 25 April 1885, p. 341

———, ‘The Solar System and Its Boasted Perfections’, *Liberator* (Melbourne, Victoria), 11 April 1885, p. 312

‘Tea Party and Lecture’, *Maitland Mercury and Hunter River General Advertiser* (Maitland, NSW), 15 April 1846, p. 2

Tebbutt, John, ‘Artificial Globes’, *Sydney Morning Herald* (Sydney, NSW), 23 May 1907, p. 8

———, ‘New South Wales and the Transit of Venus’, *Sydney Morning Herald* (Sydney, NSW), 21 April 1875, p. 7

———, ‘The Transit of Venus’, *Sydney Morning Herald* (Sydney, NSW), 5 February 1875, p. 2

‘Tenants of Space’, *Ballarat Star* (Ballarat, Victoria), 11 August 1887, p. 4

‘The Anti-Transportation League’, *Argus* (Melbourne, Victoria), 3 February 1851, p. 4

‘The Australian Comet’, *South Australian Register* (Adelaide, SA), 12 April 1843, p. 3

‘The Closing of the Theatres on Sundays’, *Sydney Morning Herald* (Sydney, NSW), 14 June 1887, p. 4

‘The Colonial Office and the Colonies’, *Sydney Mail* (Sydney, NSW), 29 January 1870, pp. 6–7

‘The Comet’, *Geelong Advertiser* (Geelong, Victoria), 6 March 1843, p. 2

———, *Colonial Times* (Hobart, Tasmania), 11 April 1843, p. 3

———, *Southern Australian* (Adelaide, SA), 10 March 1843, p. 2

———, *Southern Australian* (Adelaide, SA), 24 March 1843, pp. 2–3

———, *Southern Australian* (Adelaide, SA), 28 April 1843, pp. 2–3

———, *Maitland Mercury and Hunter River General Advertiser* (Maitland, NSW), 8 February 1845, p. 1

———, *Maitland Mercury and Hunter River General Advertiser* (Maitland, NSW), 18 January 1845, pp. 2–3

———, *Maitland Mercury and Hunter River General Advertiser* (Maitland, NSW), 22 February 1845, pp. 2–3

———, *Melbourne Punch* (Melbourne, Victoria), 22 June 1882, p. 8

‘The Cosmopoligraphicon’, *Age* (Melbourne, Victoria), 3 May 1855, p. 7

‘The Critic. Mr. R. A. Proctor as a Lecturer’, *Australasian* (Melbourne, Victoria), 5 June 1880, p. 6

‘The Decay of Mechanics’ Institutes’, *Empire* (Sydney, NSW), 18 February 1858, p. 3

‘The End of the World’, *Advertiser* (Adelaide, SA), 1 August 1910, p. 9

‘The Expected Comet’, *Empire* (Sydney, NSW), 14 August 1872, p. 4

‘The Fate of the Last Man’, *Scientific American*, 36 (1877), 321

‘The Flight of a Soul’, *Clarence and Richmond Examiner* (Grafton, NSW), 17 October 1911, p. 3

‘The Kapunda Herald’, *Kapunda Herald and Northern Intelligencer* (Kapunda, SA), 21 August 1868, p. 2

‘The Lantern Slide’, *Age* (Melbourne, Victoria), 30 January 1937, p. 6

‘The Last Days of the World’, *Geelong Advertiser* (Geelong, Victoria), 9 September 1893, section Supplement to The Geelong Advertiser, p. 2

‘The Late Mr. F. F. Cox’, *Grenfell Record and Lachlan District Advertiser* (Grenfell, NSW), 1 December 1900, p. 1

‘The Mechanics’ Institution’, *Courier* (Hobart, Tasmania), 24 December 1845, p. 2

‘The Meeting of the British Association’, *Sydney Morning Herald* (Sydney, NSW), 19 November 1869, p. 6

‘The Meteorology of Australasia’, *South Australian Register* (Adelaide, SA), 2 January 1891, p. 7

‘The Moltke of Managers’, *Sydney Morning Herald* (Sydney, NSW), June 1914, p. 5

‘The Month’, *Illustrated Sydney News and New South Wales Agriculturalist and Grazier* (Sydney, NSW), 31 August 1872, p. 2

———, *Illustrated Sydney News* (Sydney, NSW), 31 August 1872, p. 2

‘The Nebular Hypothesis’, *Port Adelaide News* (Port Adelaide, SA), 4 May 1878, p. 4

‘The “New Education”’, *Education Gazette and Teachers’ Aid*, 20 February 1905, pp. 122–23

‘The Old Magic Lantern’, *Williamstown Chronicle* (Melbourne, Victoria), 31 January 1931, p. 2

‘The Place of Nature Study in Education’, *Education Gazette and Teachers’ Aid*, 20 January 1905, pp. 104–5

‘The Polytechnic Institute’, *Argus* (Melbourne, Victoria), 10 June 1863, p. 5

‘The Public Library’, *Argus* (Melbourne, Victoria), 7 July 1883, p. 11

———, *Age* (Melbourne, Victoria), 27 October 1893, p. 6

‘The Recent Peculiar Sunsets’, *Melbourne Punch* (Melbourne, Victoria), 29 November 1883, p. 9

‘The Relations of Man to the Lower Animals’, *Age* (Melbourne, Victoria), 1 August 1863

‘The Rev. Dr. Scoresby’s Lecture—The Magnetism of Iron Vessels’, *Argus* (Melbourne, Victoria), 5 May 1856, p. 4

‘The Royal Polytechnic’, *Empire* (Sydney, NSW), 2 June 1854, p. 2

‘The Scare of Halley’s Comet’, *Maitland Daily Mercury* (Maitland, NSW), 2 July 1910, p. 8

‘The Solar Eclipse’, *South Australian Register* (Adelaide, SA), 8 April 1856, p. 3

———, *Sydney Morning Herald* (Sydney, NSW), 12 March 1857, p. 8

———, *Empire* (Sydney, NSW), 27 March 1857, p. 2

‘The Southern Cross’, *Daily Mercury* (Mackay, Queensland), 23 November 1936, p. 8

‘The Stars and the Earth’, *Adelaide Observer* (Adelaide, SA), 10 April 1847

‘The Steamer Comet’, *Sydney Morning Herald* (Sydney, NSW), 12 April 1843, p. 2

‘The Streets of Melbourne’, *Illustrated Australian News for Home Readers* (Melbourne, Victoria), 13 April 1874, p. 60

‘The Synagogues’, *Jewish Herald* (Melbourne, Victoria), 3 December 1880, p. 4

‘The Transit of Venus’, *Launceston Examiner* (Launceston, Tasmania), 8 October 1874, p. 2

———, *Cornwall Chronicle* (Launceston, Tasmania), 4 December 1874, p. 3

———, *Sydney Morning Herald* (Sydney, NSW), 23 April 1875, p. 7

‘The University and the Public Library’, *Argus* (Melbourne, Victoria), 4 July 1854

‘The Weather’, *Sydney Mail and New South Wales Advertiser* (Sydney, NSW), 24 January 1891, p. 181

‘The Yea Chronicle’, *Yea Chronicle* (Yea, Victoria), 19 November 1903, p. 2

Thomson, William, ‘Two-Handed or Two-Footed?’, *Argus* (Melbourne, Victoria), 22 July 1863

‘To the Editor of the Colonial Times’, *Colonial Times* (Hobart, Tasmania), 25 April 1843, p. 3

‘To the Editor of the Southern Australian’, *Southern Australian* (Adelaide, SA), 10 March 1843, p. 2

———, *Southern Australian* (Adelaide, SA), 21 April 1843, p. 3

———, *Southern Australian* (Adelaide, SA), 17 March 1843, pp. 2–3

‘To the Editor of the Sydney Monitor’, *Sydney Monitor* (Sydney, NSW), 6 December 1834, p. 3

‘Town Talk’, *Geelong Advertiser* (Geelong, Victoria), 21 October 1873, p. 2

Tumba, Wal, ‘Reminiscences. Old-Time Entertainments’, *Register* (Adelaide, SA), 30 July 1921, p. 12

‘University Council’, *Mercury* (Hobart, Tasmania), 22 January 1895, p. 2

‘University Extension Board’, *Argus* (Melbourne, Victoria), 7 April 1892, p. 9

‘University of Melbourne’, *Argus* (Melbourne, Victoria), 23 September 1863

‘University of Tasmania’, *Mercury* (Hobart, Tasmania), 21 January 1891, section The Mercury Supplement, p. 1

‘Verses’, *Sydney Gazette and New South Wales Advertiser* (Sydney, NSW), 18 November 1824, p. 4

‘Victoria’, *Evening News* (Sydney, NSW), 27 April 1880, p. 2

‘Victorian Churches and Preachers’, *Weekly Times* (Melbourne, Victoria), 24 April 1886, section Supplement, p. 7

W. M. C., ‘The Mechanics’ Institute and the Working Mens’ Club’, *Mercury* (Hobart, Tasmania), 29 March 1865, p. 2

‘Watching the Southern Cross’, *Australasian Sketcher* (Melbourne, Victoria), 20 December 1879, p. 151

‘Weather and Weather Prophets’, *Argus* (Melbourne, Victoria), 16 September 1895, p. 6

‘Weather Prophets. Wragge on Egeson’, *Burra Record* (Burra, SA), 23 December 1890, p. 3

‘Weather Prospects’, *Sydney Morning Herald* (Sydney, NSW), 28 March 1889, p. 8

‘What Australians Read’, *Cobram Courier* (Cobram, Victoria), 16 February 1893, p. 6

‘“Wife Wanted.” Rev. John Hosking Advertises’, *Truth* (Brisbane, Queensland), 9 March 1919, p. 9

‘Wiggins’s Prediction’, *Evening News* (Sydney, NSW), 10 March 1883, p. 5

Wood, W, ‘Mr. Proctor’s Lectures’, *Argus* (Melbourne, Victoria), 11 June 1880, p. 3

———, ‘Mr. Proctor’s Lectures’, *Argus* (Melbourne, Victoria), 16 June 1880, p. 7

Woolston, C. H., ‘A Lanternist’s Creed’, *The Optical Magic Lantern Journal and Photographic Enlarger*, January 1900, 2

‘Workman’s Clubs: Their Origin and Work’, *Maitland Mercury and Hunter River General Advertiser* (Maitland, NSW), 8 July 1884, p. 3

‘World’s Press Gleanings’, *Mercury* (Hobart, Tasmania), 8 January 1910, p. 8

X., ‘At the Standard’, *Freethinker* (Sydney, NSW), 5 September 1886

References

Aldiss, Brian, and David Wingrove, *Trillion Year Spree: The History of Science Fiction* (Atheneum), 1973

Altick, Richard Daniel, *The Shows of London* (Cambridge, Mass.: Belknap Press), 1978

Anderson, Katharine, 'Looking at the Sky: The Visual Context of Victorian Meteorology', *The British Journal for the History of Science*, 36 (2003), 301–32

Anderson, Warwick, *The Cultivation of Whiteness: Science, Health, and Racial Destiny in Australia* (Duke University Press), 2006

Arcangeli, Alessandro, *Cultural History: A Concise Introduction* (London; New York: Routledge), 2012

Arthur, Paul, 'Antipodean Myths Transformed: The Evolution of Australian Identity', *History Compass*, 5 (2007), 1862–1878

Austin, Albert Gordon, 'Halloran, Laurence Hynes (1765–1831)', *Australian Dictionary of Biography* (National Centre of Biography, Australian National University), 1966 <http://adb.anu.edu.au/biography/halloran-laurence-hynes-2149/text2741,> [accessed 18 August 2016]

Bailey, Peter, *Leisure and Class in Victorian England: Rational Recreation and the Contest for Control, 1830-1885* (Taylor & Francis), 2014

Baker, Donald, 'Lang, John Dunmore (1799–1878)', *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/lang-john-dunmore-2326> [accessed 3 February 2017]

Baragwanath, Pam, 'Mechanics' Insitute Libraries in Victoria, 1839-2004', in *Buildings, Books and Beyond*, 2nd ed (Prahran, Victoria: Prahran Mechanics' Institute Press), 2004, pp. 42–86

Bartlett, Frederic, *Remembering: A Study in Experimental and Social Psychology* (Cambridge, UK: The University press), 1932

Barton, Ruth, 'Sunday Lecture Societies', in *Victorian Scientific Naturalism: Community, Identity, Continuity* (Chicago: University of Chicago Press), 2014

Baum, Richard, 'Flammarion, Nicolas Camille', *Biographical Encyclopedia of Astronomers*, 2014, pp. 727–729

Beddoe, Joan, 'Schools of Arts and Technical Education in Queensland', in *Buildings, Books and Beyond*, 2nd ed (Prahran, Victoria: Prahran Mechanics' Institute Press), 2004, pp. 100–109

Beggs-Sunter, Anne, 'Remembering Eureka', *Journal of Australian Studies*, 25 (2001), 49–56

Bellanta, Melissa, 'A Hard Culture? Religion and Politics in Turn-of-the-Century Australian History', *Australian Journal of Politics & History*, 56 (2010), 55–65

Bensaude-Vincent, Bernadette, 'A Historical Perspective on Science and Its "others"', *Isis*, 100 (2009), 359–368

Bergman, George, 'Rümker, Christian Carl Ludwig (1788–1862)', *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/rumker-christian-carl-ludwig-2615> [accessed 21 September 2016]

Bexley, Emmaline, 'Absolute Time Before Newton', PhD thesis (University of Melbourne), 2009

Bigg, Charlotte, 'Staging the Heavens: Astrophysics and Popular Astronomy in the Late Nineteenth Century', in *The Heavens on Earth: Observatories and Astronomy in Nineteenth-Century Science and Culture, Ed. David Aubin and Charlotte Bigg (Durham, NC: Duke University Press, 2010)*, 2010, pp. 304–24

Bird, R., 'Enlightenment and Entertainment: The Magic Lantern in Late 18th- and Early 19th-Century Madrid', in *Realms of Light: Uses and Perceptions of the Magic Lantern from the 17th to the 21st Century : An Illustrated Collection of Essays by 27 Authors from Six Countries*, ed. by M. Heard and I. Van Dooren (Magic Lantern Society), 2005, pp. 86–91

Blackford, Russell, Van Ikin, and Sean McMullen, *Strange Constellations: A History of Australian Science Fiction*, Contributions to the Study of Science Fiction and Fantasy (Greenwood Press), 1999

Blainey, Geoffrey, *Black Kettle and Full Moon* (Penguin Group Australia), 2004

Bradshaw, Richard, 'Thiodon's Wonders: A Mechanical Theatre in Nineteenth-Century Australia', *Australasian Drama Studies*, 2007, 18

Broks, Peter, 'Science, Media and Culture: British Magazines, 1890-1914', *Public Understanding of Science*, 2 (1993), 123–39

Brooke, John, 'Natural Theology and the Plurality of Worlds: Observations on the Brewster--Whewell Debate.', *Annals of Science*, 34 (1977), 221

———, *Science and Religion: Some Historical Perspectives* (Cambridge, UK: Cambridge University Press), 1991

Bryce, Merilyn, 'On the Wool Track with a Good Book: Shearers, Shedhands and Station Schools of Arts in New South Wales', in *Buildings, Books and Beyond*, 2nd ed (Prahran, Victoria: Prahran Mechanics' Institute Press), 2004, pp. 116–21

Bucchi, Massimiano, 'Of Deficits, Deviations and Dialogues: Theories of Public Communication of Science', in *Handbook of Public Communication of Science and Technology*, ed. by Massimiano Bucchi and Brian Trench (London: Routledge), 2008, pp. 57–76

Buildings, Books and beyond: Mechanics' Worldwide Conference 2004. Proceedings of an International Conference Convened by the Mechanics' Institutes of Victoria at Swinburne University, Prahran Campus, Melbourne, Australia, 2-4 September 2004, 2nd ed (Prahran, Victoria: Prahran Mechanics' Institute Press), 2004

Burke, Edmund, *A Philosophical Enquiry Into the Sublime and Beautiful*, Classics Series (Penguin Books Limited), 1998

Burke, Peter, *Eyewitnessing : The Uses of Images as Historical Evidence* (Ithaca, N.Y.: Cornell University Press), 2001

———, 'Strengths and Weaknesses of the History of Mentalities', *History of European Ideas*, 7 (1986), 439–451

Bush, Martin, 'Orrery', in *Treasures of the Museum* (Melbourne: Museum Victoria), 2004, p. 13

Butcher, Barry, 'Darwinism and Australia', PhD thesis, 1992

———, 'Darwinism Down Under: Science, Religion and Evolution in Australia', in *Disseminating Darwinism: The Role of Place, Race, Religion, and Gender* (Cambridge, UK: Cambridge University Press), 2001, pp. 39–60

———, 'Gorilla Warfare in Melbourne: Halford, Huxley and "Man"s Place in Nature'', in *Australian Science in the Making* (Cambridge, UK: Cambridge University Press), 1990, pp. 153–69

Butterworth, Mark, 'Astronomical Lantern Slides', *The Magic Lantern Gazette*, 19 (2007), 3–11

Cable, Kenneth, 'Broughton, William Grant (1788–1853)', *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/broughton-william-grant-1832> [accessed 21 September 2016]

Callon, Michel, 'Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay', *Power, Action and Belief: A New Sociology of Knowledge*, 32 (1986), 196–233

Candy, Philip C, and John Laurent, eds., *Pioneering Culture: Mechanics' Institutes and Schools of Arts in Australia* (Adelaide: Auslib Press), 1994

Cane, R F, 'John H. Pepper: Analyst and Rainmaker: The Genesis of Chemistry Teaching in Queensland', *Journal of the Royal Historical Society of Queensland*, 9 (1975), 116–33

Clark, Barry, 'Influences of German Science and Scientists on Melbourne Observatory', *Proceedings of the Royal Society of Victoria*, 127 (2015), 43–58

Clark, Manning, *A Short History of Australia*, A Penguin Book. History (Penguin Group Australia), 2006

Clarke, Philip, *Aboriginal Plant Collectors: Botanists and Australian Aboriginal People in the Nineteenth Century* (Rosenberg Pub.), 2008

Clements, Helen, 'Science and Colonial Culture: Scientific Interests and Institutions in Brisbane, 1859-1900', PhD thesis (Griffith University), 1999

Cohn, Norman, *The Pursuit of the Millennium: Revolutionary Millenarians and Mystical Anarchists of the Middle Ages* (London: Paladin), 1970

Colligan, Mimi, *Canvas Documentaries: Panoramic Entertainments in Nineteenth-Century Australia and New Zealand* (Melbourne: Melbourne University Press), 2002

Collins, Hugh, 'Political Ideology in Australia: The Distinctiveness of a Benthamite Society', *Daedalus*, 114 (1985), 147–69

Connerton, Paul, *How Societies Remember* (Cambridge, UK: Cambridge University Press), 1989

Cooter, Roger, and Stephen Pumfrey, 'Separate Spheres and Public Places: Reflections on the History of Science Popularization and Science in Popular Culture', *History of Science*, 32 (1994)

Cowie, Phillip, 'Friend, Matthew Curling (1792–1871)', *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/friend-matthew-curling-2069> [accessed 21 September 2016]

Crary, J., *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century*, October Books (MIT Press), 1992

Crompton, Dennis, Richard Franklin, Stephen Herbert, and Magic Lantern Society of Great Britain, *Servants of Light: The Book of the Lantern* (Ripon, North Yorkshire: The Magic Lantern Society), 1997

Crowe, Michael, 'Astronomy and Religion (1780-1915) - Four Case Studies Involving Ideas of Extraterrestrial Life', *Osiris*, 16 (2001), 209–26

———, *The Extraterrestrial Life Debate, 1750-1900* (Dover Publications), 1999

Curthoys, A., and J. Schultz, *Journalism: Print, Politics and Popular Culture*, Uqp Australian Studies (University of Queensland Press), 1999

Daston, Lorraine, 'Science Studies and the History of Science', *Critical Inquiry*, 35 (2009), 798–813

Daston, Lorraine, and Peter Galison, *Objectivity* (Zone Books), 2007

Daum, Andreas, 'Varieties of Popular Science and the Transformations of Public Knowledge: Some Historical Reflections', *Isis*, 100 (2009), 319–32

Davis, Natalie Zemon, *The Return of Martin Guerre* (Cambridge, Mass.: Harvard University Press), 1983

Davison, Graeme, *The Unforgiving Minute: How Australians Learned to Tell the Time*, ACLS Humanities E-Book (Oxford University Press), 1993

Dikovistskaya, M, *Visual Culture: The Study Of The Visual After The Cultural Turn* (MIT Press), 2005

Dowling, Peter, 'The Culture of Newspapers in Australia from the 1880s to the 1920s' (presented at the History of the Book in Australia, Sydney, NSW), 1996

Dunstan, David, ‘Exhibitionary Complex Personified: Melbourne’s Nineteenth Century Displays and the Mercurial Dr L L Smith’, in *Seize the Day : Exhibitions, Australia and the World*, ed. by Kate Darian-Smith (Clayton, Vic. : Monash University ePress), 2008, p. 9.1-9.18

Elkins, James, *The Domain of Images* (Ithaca, N.Y.: Cornell University Press), 1999

Erdos, Renee, ‘Leichhardt, Friedrich Wilhelm Ludwig (1813–1848)’, *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/leichhardt-friedrich-wilhelm-ludwig-2347> [accessed 20 September 2016]

Esguerra, Jorge Canizares, ‘New World, New Stars: Patriotic Astrology and the Invention of Indian and Creole Bodies in Colonial Spanish America, 1600-1650’, *American Historical Review*, 104 (1999), 33–33

Fara, Patricia, ‘Object Lessons’, *Isis*, 107 (2016), 785–88

Featherstone, Guy, ‘Bonwick, James (1817–1906)’, *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/bonwick-james-3022> [accessed 21 September 2016]

———, ‘Smith, Louis Lawrence (1830–1910)’, *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/smith-louis-lawrence-4610> [accessed 21 September 2016]

Fine, Cordelia, and Emma Rush, ‘“Why Does All the Girls Have to Buy Pink Stuff?” The Ethics and Science of the Gendered Toy Marketing Debate’, *Journal of Business Ethics*, 2016, 1–16

Fleck, Ludwik, *Genesis and Development of a Scientific Fact* (Chicago: University of Chicago Press), 1981

Gascoigne, Ben, ‘Ellery, Robert Lewis (1827–1908)’, *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/ellery-robert-lewis-3477> [accessed 21 September 2016]

Gillespie, Neal, ‘Natural History, Natural Theology, and Social Order: John Ray and the “Newtonian Ideology”’, *Journal of the History of Biology*, 20 (1987), 1–49

Gillespie, Richard, *The Great Melbourne Telescope* (Melbourne: Museum Victoria), 2011

Ginzburg, Carlo, John Tedeschi, and Anne Tedeschi, *The Cheese and the Worms: The Cosmos of a Sixteenth-Century Miller*, New ed (London: Penguin Books), 1992

Goldie, Matthew, *The Idea of the Antipodes: Place, People, and Voices* (Taylor & Francis), 2010

Golinski, Jan, *British Weather and the Climate of Enlightenment* (Chicago: University of Chicago Press), 2010

———, *Making Natural Knowledge: Constructivism and the History of Science, with a New Preface*, Cambridge History of Science (Chicago: University of Chicago Press), 2008

———, 'Sublime Astronomy: The Eidouranion of Adam Walker and His Sons', *Huntington Library Quarterly*, 80 (2017), 135–57

———, *The Experimental Self: Humphry Davy and the Making of a Man of Science*, Synthesis (University of Chicago. Press) (Chicago: University of Chicago Press), 2016

Gombrich, Ernst, *Art and Illusion: A Study in the Psychology of Pictorial Representation* (London: Phaidon), 1959

Gray, Nancy, 'Bingle, John (1796–1882)', *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/bingle-john-1780> [accessed 21 September 2016]

Griffiths, Tom, '"The Natural History of Melbourne": The Culture of Nature Writing in Victoria, 1880–1945', *Australian Historical Studies*, 23 (1989), 339–65

Gunning, Tom, *D.W. Griffith and the Origins of American Narrative Film: The Early Years at Biograph*, Illini Books Edition (University of Illinois Press), 1994

———, 'Introduction', in *The Great Art of Light and Shadow: Archaeology of the Cinema*, Exeter Studies in Film History (University of Exeter Press), 2000

———, '"Primitive" Cinema: A Frame-up? Or the Trick's on Us', *Cinema Journal*, 28 (1989), 3–12

———, 'The Scene of Speaking: Two Decades of Discovering the Film Lecturer', *IRIS-PARIS-*, 27 (1999), 67–80

Hamacher, Duane, 'On the Astronomical Knowledge and Traditions of Aboriginal Australians', PhD thesis (Macquarie University), 2011

Harris, HL, 'The Influence of Chartism in Australia', *The Royal Australasian Historical Society: Journals and Proceedings*, 1926, 351–378

Hartrick, Elizabeth, 'Consuming Illusions: The Magic Lantern in Australia & Aotearoa/New Zealand', PhD thesis (University of Melbourne), 2003

Haynes, Raymond, *Explorers of the Southern Sky: A History of Australian Astronomy* (Cambridge ; New York: Cambridge University Press), 1996

Hilgartner, Stephen, 'The Dominant View of Popularization: Conceptual Problems, Political Uses', *Social Studies of Science*, 20 (1990), 519–39

Huang, Hsiang-Fu, 'Commercial and Sublime: Popular Astronomy Lectures in Nineteenth Century Britain', PhD thesis (University College London), 2015

Hudson, John, Anetta Caplanova, and Marcel Novak, 'Public Attitudes to GM Foods. The Balancing of Risks and Gains', *Appetite*, 92 (2015), 303–13

Hutton, Charles, Georges Shaw, and Richard Pearson, *The Philosophical Transactions of the Royal Society of London, from Their Commencement, in 1665, to the Year 1800*, 1809, IX

Inkster, Ian, and Jan Todd, 'Support for the Scientific Enterprise, 1850-1900', in *Australian Science in the Making* (Cambridge, UK: Cambridge University Press), 1990, pp. 102–9

Jamison, Bryan, ‘Making “honest, Truthful and Industrious Men”: Newsboys, Rational Recreation and the Construction of the “Citizen” in Late Victorian and Edwardian Brisbane.’, *Journal of Popular Culture*, 33 (1999), 61–75

Johnson, Dianne, *Night Skies of Aboriginal Australia: A Noctuary* (Oceania Publications, University of Sydney), 1998

Johnson, Jim, ‘Mixing Humans and Nonhumans Together: The Sociology of a Door-Closer’, *Social Problems*, 35 (1988), 298–310

Johnson, Stuart, ‘The Shaping of Colonial Liberalism: John Fairfax and the Sydney Morning Herald, 1841-1877’, PhD thesis (University of New South Wales), 2006

Johnstone, Samuel, and J. H. L Johnstone, *The Book of St. Andrew’s Cathedral, Sydney*, Rev. ed (Sydney: Angus and Robertson), 1968

Kardoss, John, *A Brief History of the Australian Theatre* (Sydney: Sydney University Dramatic Society, University of Sydney), 1955

Karnfelt, Johan, ‘The Popularization of Astronomy in Early Twentieth-Century Sweden: Aims and Motives’, in *Popularizing Science and Technology in the European Periphery, 1800-2000*, ed. by F Papanelopoulou, A N Galán, and E Perdiguero, 2009, pp. 175–94

Kember, J., *Marketing Modernity: Victorian Popular Shows and Early Cinema*, Exeter Studies in Film History (University of Exeter Press), 2015

Kerwin, Dale, *Aboriginal Dreaming Paths and Trading Routes : The Colonisation of the Australian Economic Landscape* (Sussex Academic Press), 2010

King, H.C., and J.R. Millburn, *Geared to the Stars: The Evolution of Planetariums, Orreries, and Astronomical Clocks* (University of Toronto Press), 1978

Kragh, Helge, ‘Conclusion, and a Note on the Satellites of Uranus’, in *The Moon That Wasn’t: The Saga of Venus’ Spurious Satellite* (Basel: Birkhäuser Basel), 2008, pp. 145–54

Küçük, B. Harun, ‘Darnton’s Cats, Bacon’s Rifle, and History of Science 101’, *Isis*, 107 (2016), 793–95

Kulberg, Øivind, ‘From Rock Carvings to Carving Skis’, *Skiing Heritage Journal*, 19 (2007), 34–37

Kwan, Elizabeth, *Flag and Nation: Australians and Their National Flags since 1901*, EBL-Schweitzer (Kensington, NSW: UNSW Press), 2006

Lakoff, George, *Women, Fire, and Dangerous Things: What Categories Reveal about the Mind* (Chicago: University of Chicago Press), 1987

Lakoff, George, and Mark Johnson, *Metaphors We Live by* (Chicago; London: University of Chicago Press), 1980

Latour, Bruno, ‘For David Bloor... and Beyond: A Reply to David Bloor’s’ Anti-Latour’’, *Studies in History and Philosophy of Science Part A*, 30 (1999), 113–30

———, ‘On Recalling ANT’, *The Sociological Review*, 47 (1999), 15–25

Laurent, John, 'Science, Society and Politics in Late Nineteenth-Century England: A Further Look at Mechanics' Institutes', *Social Studies of Science*, 14 (1984), 585–619

Law, John, 'Actor-Network Theory and Material Semiotics', in *The New Blackwell Companion to Social Theory*, ed. by B S Turner (Wiley), 2009, pp. 141–58

———, 'Objects and Spaces', *Theory, Culture & Society*, 19 (2002), 91–105

Leane, Elizabeth, *Reading Popular Physics: Disciplinary Skirmishes and Textual Strategies* (Ashgate), 2007

Lightman, Bernard, 'Marketing Knowledge for the General Reader: Victorian Popularizers of Science', *Endeavour*, 24 (2000), 100–106

———, 'The Visual Theology of Victorian Popularizers of Science: From Reverent Eye to Chemical Retina', *Isis*, 91 (2000), 651–80

———, *Victorian Popularizers of Science: Designing Nature for New Audiences* (Chicago: University of Chicago Press), 2009

———, 'Victorian Sciences and Religions: Discordant Harmonies', *Osiris*, 16 (2001), 343–66

Lindesay, Vane, 'Marquet, Claude Arthur (1869–1920)', *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/marquet-claude-arthur-7495> [accessed 22 September 2016]

Lineham, Peter, 'Christian Reaction to Freethought and Rationalism in New Zealand', *The Journal of Religious History*, 15 (1988), 236–250

———, 'Freethinkers in 19th Century New Zealand', *New Zealand Journal of History*, 19 (1985), 61–81

Lockley, G. L., 'Price, Charles (1807–1891)', *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/price-charles-2562> [accessed 21 September 2016]

Lunteren, Frans van, 'Clocks to Computers: A Machine-Based "Big Picture" of the History of Modern Science', *Isis*, 107 (2016), 762–76

Lyons, Martyn, and John Arnold, *A History of the Book in Australia, 1891-1945: A National Culture in a Colonised Market*, A History of the Book in Australia (St Lucia, Queensland: University of Queensland Press), 2001

Macintyre, Stuart, *A Concise History of Australia*, A Concise History of Australia (Cambridge, UK: Cambridge University Press), 2009

MacLeod, Roy, *The Commonwealth of Science: ANZAAS and the Scientific Enterprise in Australasia, 1888-1988* (Melbourne: Oxford University Press), 1988

———, 'The "Practical Man": Myth and Metaphor in Anglo-Australian Science', *Australian Cultural History*, 8 (1989), 24–49

Mander-Jones, Phyllis, 'Dawes, William (1762–1836)', *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/dawes-william-1968> [accessed 21 September 2016]

Mannoni, Laurent, *The Great Art of Light and Shadow: Archaeology of the Cinema*, trans. by Richard Crangle, Exeter Studies in Film History (University of Exeter Press), 2000

Mar, Tracey, and Penelope Edmonds, 'Introduction', in *Making Settler Colonial Space: Perspectives on Race, Place and Identity* (Palgrave Macmillan UK), 2010, pp. 1–24

Martin, Allan, 'Henry Parkes and the Political Manipulation of Sectarianism', *Journal of Religious History*, 9 (1976), 85–92

———, 'Henry Parkes: Man and Politician', *Melbourne Studies in Education*, 4 (1960), 1–24

———, 'Parkes, Sir Henry (1815–1896)', *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/parkes-sir-henry-4366> [accessed 21 September 2016]

Masia, Seth, '150 Years of Skiing Down Under', *Skiing Heritage Journal*, 23 (2011), 6

McColley, Grant, 'The Seventeenth-Century Doctrine of a Plurality of Worlds', *Annals of Science*, 1 (1936), 385–430

McFarlane, Bruce, 'Jensen, Harald Ingemann (1879–1966)', *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/jensen-harald-ingemann-6839> [accessed 22 September 2016]

McLean, Ian W., *Why Australia Prospered: The Shifting Sources of Economic Growth* (Princeton University Press), 2012

McNicoll, Ronald, 'Riddell, John Carre (1809–1879)', *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/riddell-john-carre-4476> [accessed 21 September 2016]

Meadmore, Peter, 'The Introduction of the "new Education" in Queensland, Australia', *History of Education Quarterly*, 43 (2003), 372–375

Mirams, Sarah, '"For Their Moral Health": James Barrett, Urban Progressive Ideas and National Park Reservation in Victoria', *Australian Historical Studies*, 33 (2002), 249–266

Mitchell, William, 'There Are No Visual Media', *Journal of Visual Culture*, 4 (2005), 257–66

Morris, Roger, and Lucy Bantermalis, 'Five Sydney Workingmen's Institutes', in *Buildings, Books and Beyond*, 2nd ed (Prahran, Victoria: Prahran Mechanics' Institute Press), 2004, pp. 290–97

Morrison, Doug, and Ivan Barko, 'Dagelet and Dawes: Their Meeting, Their Instruments and the First Scientific Experiments on Australian Soil', *Historical Records of Australian Science*, 20 (2009), 1–40

Morus, Iwan, ‘Seeing and Believing Science’, *Isis*, 97 (2006), 101–10

Mozley, Ann, ‘Clarke, William Branwhite (1798–1878)’, *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/clarke-william-branwhite-3228> [accessed 21 September 2016]

Murray, Robert, and Jim Usher, ‘Argus’, in *A Companion to the Australian Media*, ed. by Bridget Griffen-Foley (Australian Scholarly), 2014, pp. 24–25

Nadel, George, *Australia’s Colonial Culture: Ideas, Men, and Institutions in Mid-Nineteenth Century Eastern Australia* (Cambridge, Mass.: Harvard University Press), 1957

Nall, Joshua, ‘New from Mars: Transatlantic Mass Media and the Practice of New Astronomy. 1870-1910’, PhD thesis (Cambridge University), 2013

Natale, Simone, and Gabriele Balbi, ‘Media and the Imaginary in History’, *Media History*, 20 (2014), 203–18

Numbers, Ronald, ‘Science and Religion’, *Osiris*, 1 (1985), 59–80

O’Connor, Ralph, ‘Reflections on Popular Science in Britain: Genres, Categories, and Historians’, *Isis*, 100 (2009), 333–45

O’Farrell, Patrick, ‘The Australian Socialist League and the Labour Movement, 1887–1891’, *Historical Studies: Australia and New Zealand*, 8 (1958), 152–65

O’Neill, Sally, ‘Meredith, Louisa Ann (1812–1895)’, *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/meredith-louisa-ann-4435> [accessed 21 September 2016]

Orchiston, Wayne, ‘Amateur-Professional Collaboration in Australian Science : The Earliest Astronomical Groups and Societies’, *Orchiston, W. (1900). Amateur-Professional Collaboration in Australian Science : The Earliest Astronomical Groups and Societies.*, 12 (1998), 163–82

———, ‘Australia’s Earliest Planispheres’, *Journal of the British Astronomical Association*, 113 (2003), 329–332

———, ‘Comets and Communication : Amateur – Professional Tension in Australian Astronomy’, *Publications of the Astronomical Society of Australia*, 16 (1999), 212–21

———, ‘Contribution of the Lands Department to the Development of Astronomy in New South Wales during the Nineteenth Century’, *Australian Journal of Astronomy*, 2 (1987), 65–74

———, ‘John Tebbutt and Observational Astronomy at Windsor Observatory’, *Journal of the British Astronomical Association*, 114 (2004), 141–54

———, ‘Power, Politics and Prestige: The Russell–Tebbutt Feud’, in *John Tebbutt: Rebuilding and Strengthening the Foundations of Australian Astronomy*, ed. by Wayne Orchiston (Cham: Springer International Publishing), 2017, pp. 393–448

———, 'The Contribution of Francis Abbott to Tasmanian and Australian Astronomy', *Vistas in Astronomy*, 35, Part 3 (1992), 315–44

———, 'The Contribution of Francis Abbott to Tasmanian and Australian Astronomy', *Vistas in Astronomy*, 35, Part 3 (1992), 315–44

———, 'The Nineteenth Century Transits of Venus: An Australian and New Zealand Overview', *Journal of Astronomical Data*, 10 (2004), 219

———, 'The Role of the Amateur in Popularizing Astronomy: An Australian Case Study.', *Australian Journal of Astronomy*, 7 (1997), 33–66

Organ, Michael, 'W.B. Clarke as Scientific Journalist', *Historical Records of Australian Science*, 9 (1992), 1–16

Orthia, Lindy, '"Laudably Communicating to the World": Science in Sydney's Public Culture, 1788–1821', *Historical Records of Australian Science*, 27 (2016), 1–12

Otter, Chris, *The Victorian Eye: A Political History of Light and Vision in Britain, 1800-1910* (Chicago: University of Chicago Press), 2008

Perkins, Maureen, '"An Era of Great Doubt to Some in Sydney": Almanacs and Astrological Belief in Colonial Australia', *Journal of Religious History*, 17 (1993), 465–74

———, 'Australian Almanacs: An Argument for Their Inclusion in a History of the Book in Australia', *Bulletin of the Bibliographical Society of Australia and New Zealand*, 19 (1995), 219–30

———, *Visions of the Future: Almanacs, Time, and Cultural Change, 1775-1870* (Clarendon Press), 1996

Phillips, Donald, 'Independent Methodism in New Zealand'

Phillips, Patricia, *The Scientific Lady: A Social History of Women's Scientific Interests, 1520-1918* (London, UK: Weidenfeld and Nicolson), 1990

Phillips, Walter, 'Jefferis, James (1833–1917)', *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/jefferis-james-3853> [accessed 21 September 2016]

———, 'The Churches and the Sunday Question in Sydney in the 1880s', *Journal of Religious History*, 6 (1970), 41–61

———, 'The Defence of Christian Belief in Australia 1875–1914: The Responses to Evolution and Higher Criticism', *Journal of Religious History*, 9 (1977), 402–423

Pickering, Paul, 'Betrayal and Exile: A Forgotten Chartist Experience', in *Unrespectable Radicals?: Popular Politics in the Age of Reform* (Taylor & Francis), 2016, pp. 201–18

Pieterse, Jan Nederveen, 'Fictions of Europe', *Race & Class*, 32 (1991), 1–10

Poynter, John, *The Audacious Adventures of Dr Louis Laurence Smith: 1830-1910*, The Audacious Adventures of Dr Louis Laurence Smith: 1830-1910, v. 1 (Australian Scholarly Publishing), 2013

Quinn, Naomi, 'How to Reconstruct Schemas People Share, From What They Say', in *Finding Culture in Talk: A Collection of Methods*, ed. by Naomi Quinn (New York: Palgrave Macmillan US), 2005, pp. 35–81

Reynolds, John, 'West, John (1809–1873)', *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/west-john-2784> [accessed 20 September 2016]

Richards, Eric, 'How Did Poor People Emigrate from the British Isles to Australia in the Nineteenth Century?', *Journal of British Studies*, 32 (1993), 250–279

Richards, Joan L, *Mathematical Visions: The Pursuit of Geometry in Victorian England* (Academic Press), 1988

Richardson, Keith, 'Polliwogs and Shellbacks: An Analysis of the Equator Crossing Ritual', *Western Folklore*, 36 (1977), 154–159

Rickard, John, *Australia: A Cultural History* (London ; New York: Longman), 1988

Roberts, Stephen, *The Chartist Prisoners: The Radical Lives of Thomas Cooper (1805-1892) and Arthur O'Neill (1819-1896)* (Peter Lang), 2008

Roe, Michael, 'Lillie, John (1806–1866)', in *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University)

Rossell, Deac, *Living Pictures: The Origins of the Movies*, SUNY Series, Cultural Studies in Cinema/Video (State University of New York Press), 1998

Rothermel, Holly, 'Images of the Sun: Warren De La Rue, George Biddell Airy and Celestial Photography', *The British Journal for the History of Science*, 26 (1993), 137–69

Royle, Edward, *Radicals, Secularists, and Republicans: Popular Freethought in Britain, 1866-1915* (Manchester, UK: Manchester University Press), 1980

Rudwick, Martin, *The Great Devonian Controversy: The Shaping of Scientific Knowledge among Gentlemanly Specialists*, Science and Its Conceptual Foundations Series (Chicago: University of Chicago Press), 1985

Rumelhart, David E, 'Schemata and the Cognitive System', *Handbook of Social Cognition*, 1 (1984), 161–188

Russell, Colin, 'The Conflict of Science and Religion', in *Science and Religion: A Historical Introduction*, ed. by G.B. Ferngren, A Johns Hopkins Paperback (Johns Hopkins University Press), 2002, pp. 3–12

Russell, John, Rod Kirkpatrick, Victor Isaacs, and Australian Newspaper History Group, *Australian Newspaper History: A Bibliography*, Second edition, 2009 (Andergrove (Mackay), Queensland Australian Newspaper History Group), 2009

Said, Edward, *Orientalism* (Penguin Group), 2006

Saum, Lewis O, 'The Proctor Interlude in St. Joseph and in America: Astronomy, Romance and Tragedy', *American Studies International*, XXXVII (1999), 34–54

Saunders, Shirley, 'Sir Thomas Brisbane's Legacy to Colonial Science: Colonial Astronomy at the Parramatta Observatory, 1822–1848', *Historical Records of Australian Science*, 15 (2004), 177–209

Schaffer, Simon, 'Transport Phenomena: Space and Visibility in Victorian Physics', *Early Popular Visual Culture*, 10 (2012), 71–91

Schechner, Sara, *Comets, Popular Culture, and the Birth of Modern Cosmology*, Princeton Paperbacks (Princeton, N. J.: Princeton University Press), 1999

Secord, Anne, 'Science in the Pub: Artisan Botanists in Early Nineteenth-Century Lancashire', *History of Science*, 32 (1994), 269–315

Secord, James, 'Knowledge in Transit', *Isis*, 95 (2004), 654–72

———, *Visions of Science: Books and Readers at the Dawn of the Victorian Age* (Oxford University Press), 2014

Serle, Geoffrey, *From Deserts the Prophets Come: The Creative Spirit in Australia 1788-1972* (Melbourne: Heinemann), 1973

Shapin, Steven, and Barry Barnes, 'Science, Nature and Control: Interpreting Mechanics' Institutes', *Social Studies of Science*, 1977

Shillingsburg, M., 'Smythe, Robert Sparrow (1833–1917)', *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/smythe-robert-sparrow-8568> [accessed 21 September 2016]

Silverberg, Robert, 'Introduction', in *Omega: The Last Days of the World*, Bison Frontiers of Imagination Series (University of Nebraska Press), 1999, pp. v–xi

Smith, Barry, 'Symes, Joseph (1841–1906)', *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/symes-joseph-4681> [accessed 26 January 2016]

Smith, Bernard, *European Vision and the South Pacific* (London: Ebenezer Baylis and Son), 1950

Smith, F. B., 'Joseph Symes and the Australasian Secular Association', *Labour History*, 1963, 26–47

Smith, Robert, and Richard Baum, 'William Lassell and the Ring of Neptune: A Case Study in Instrumental Failure', *Journal for the History of Astronomy*, 15 (1984), 1–17

Spencer, Douglas Arthur, and Hubert D. Waley, *The Cinema Today*, 2nd ed (London: Oxford University Press), 1956

Stenhouse, John, 'Collins, William Whitehouse', *Te Ara: The Encyclopaedia of New Zealand*, 2013 <http://www.teara.govt.nz/en/biographies/2c27/collins-william-whitehouse> [accessed 22 September 2016]

Theobald, Marjorie, *Knowing Women: Origins of Women's Education in Nineteenth-Century Australia* (Cambridge, UK: Cambridge University Press), 1996

Todd, Jan, *Colonial Technology: Science and the Transfer of Innovation to Australia*, Studies in Australian History (Cambridge, UK: Cambridge University Press), 1995

Tolley, Kim, 'Science for Ladies, Classics for Gentlemen: A Comparative Analysis of Scientific Subjects in the Curricula of Boys' and Girls' Secondary Schools in the United States, 1794-1850', *History of Education Quarterly*, 36 (1996), 129–153

Topham, Jonathan, 'A View from the Industrial Age', *Isis*, 95 (2004), 431–42

———, 'Rethinking the History of Science Popularization/Popular Science', in *Popularizing Science and Technology in the European Periphery, 1800-2000*, ed. by F Papanelopoulou, A N Galán, and E Perdiguero (Ashgate Pub.), 2009, pp. 1–20

———, 'Science and Popular Education in the 1830s: The Role of the Bridgewater Treatises', *The British Journal for the History of Science*, 25 (1992), 397–430

Turner, Frank, 'Public Science in Britain, 1880-1919', *Isis*, 71 (1980), 589–608

Veracini, Lorenzo, 'Historylessness: Australia as a Settler Colonial Collective', *Postcolonial Studies*, 10 (2007), 271–285

———, *Settler Colonialism: A Theoretical Overview* (Basingstoke: Palgrave Macmillan), 2010

Wahl-Jorgensen, Karin, 'Letters to the Editor as a Forum for Public Deliberation: Modes of Publicity and Democratic Debate', *Critical Studies in Media Communication*, 18 (2001), 303–20

Wallis, Helen, 'The Place of Globes in English Education, 1600-1800', *Der Globusfreund*, 1978, 103–10

Walsh, Gerald, 'Russell, Henry Chamberlain (1836–1907)', *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/russell-henry-chamberlain-4525> [accessed 21 September 2016]

Ward, Russell, *The Australian Legend* (Oxford University Press), 1978

Waterhouse, Richard, *From Minstrel Show to Vaudeville : The Australian Popular Stage 1788-1914* (Kensington, NSW: NSW University Press), 1990

Waters, David, *English Navigational Books, Charts and Globes Printed Down to 1600*, Centro de Estudios de História E Cartografia Antiga: Série Separatas (Instituto de Investigação Científica Tropical), 1985

Webby, Elizabeth, 'Reading in Colonial Australia: The 2011 John Alexander Ferguson Memorial Lecture', *Journal of the Royal Australian Historical Society*, 97 (2011), 119

Werskey, Gary, *The Visible College: A Collective Biography of British Scientists and Socialists of the 1930s* (Free Association Books), 1988

Whitley, Richard, and Terry Shinn, eds., *Expository Science: Forms and Functions of Popularisation* (Dordrecht, Holland: Boston D. Reidel Pub. Co), 1985

Wickberg, Daniel, ‘Intellectual History vs. the Social History of Intellectuals’, *Rethinking History*, 5 (2001), 383–95

Willis, R. W. G., ‘Greeves, Augustus Frederick (1805–1874)’, *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/greeves-augustus-frederick-3662> [accessed 21 September 2016]

Wilson, Paul, ‘Wragge, Clement Lindley (1852–1922)’, *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/wragge-clement-lindley-9193> [accessed 21 September 2016]

Wood, Harley, ‘Tebbutt, John (1834–1916)’, *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/tebbutt-john-4696> [accessed 21 September 2016]

Woods, Carole, ‘Haddon, Frederick William (1839–1906)’, *Australian Dictionary of Biography* (Canberra: National Centre of Biography, Australian National University) <http://adb.anu.edu.au/biography/haddon-frederick-william-3686> [accessed 21 September 2016]

Wright, Clare, *The Forgotten Rebels of Eureka* (Text Publishing Company), 2014