

## Book Reviews

Compiled by Peter Hobbins

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**David Mabberley:** *Painting by Numbers: the Life and Art of Ferdinand Bauer*. NewSouth Publishing: Sydney, 2017. 272 pp., illus., ISBN: 9781742235226 (HB), \$69.99.

*Painting by Numbers* is the epitome of a good book on the history of science illustration. It has superbly reproduced images and an eminently scholarly text, but one that is accessible and engaging,

venturing into the present and giving its subject contemporary relevance. This success is perhaps not surprising. Its author, David Mabberley, is a plant specialist and science historian who has undertaken extensive field work in Africa, Asia and Australasia; worked at Royal Botanic Gardens Kew; was CEO of Greening Australia (NSW); is the former director of the Royal Botanic Garden Sydney and was awarded a prize for ‘successful efforts to popularize botany to non-scientists’.

Mabberley’s subject, Ferdinand Bauer, is often regarded as the foremost natural history artist to have worked primarily in the field, as opposed to the studio. His botanical and zoological paintings are stunningly beautiful in perception and rendition and full of vitality. Every beetle and bee, vibrant parrot, elegant seahorse, delicate orchid, or luscious passionflower is so accurately transposed to paper that we can almost smell the perfume of the flowers, or feel the feathers of the bird. The book approaches Bauer’s work from the perspective of method. It explains how he coded his field drawings with numbers that corresponded to a palette of colours—in much the same way as the Pantone colour matching system is used in the printing industry today—and finished them later. It is replete with Bauer’s coded drawings, often showing the finished painting on the opposite page.

The book begins with a brief introduction and background to Bauer’s working life and his family’s interest in illustration: his brothers were also natural history artists. It includes early colour charts that may have influenced Bauer and information about the naturalists for whom he worked. The major sections of the book are arranged chronologically and geographically. The areas he principally worked in were Vienna—where he grew up—plus the Mediterranean, the Pacific and Australia. When Bauer finally returned to Europe he finished hundreds of paintings, which then

adorned texts such as *Flora Graeca*, *Fauna Graeca*, and *Florae Novae Hollandiae*. Two short chapters at the end of the book recount his final years and his legacy. Most of the material is based on holdings in Vienna and Australia, but the text takes a ‘fresh look’ at the images in the context of present preoccupations—new methods of research and new approaches to recording it.

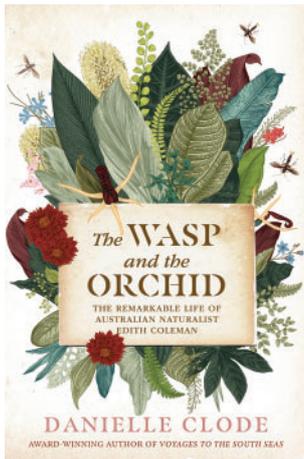
Ferdinand Bauer himself is something of an enigma and this elusiveness adds to the appeal of Mabberley’s story. When Bauer was quite young his father died and his formal education was interrupted. As a result, Bauer had little propensity to write letters or a journal, so little is known of how he came to his method or his impressions of the places he visited. However, Mabberley quotes the men with whom Bauer travelled in *Investigator*—Commander Matthew Flinders and naturalist Robert Brown—giving some insight into Bauer the man. A constant refrain is his aptitude, industry and the obvious pleasure he found in drawing flora and fauna.

Of particular interest is Bauer’s stay in the 14-year-old colony of New South Wales, where he lodged at Anson’s Farm, now the Royal Botanic Gardens Sydney, and collected plants at Bennelong Bay and Wollomooloo. *Painting by Numbers* is full of interesting details relating to his work—for instance, that 29,000 hand coloured plates from John Sidthorpe’s ten-volume *Flora* are available on the internet and that Bauer used a light box, camera obscura and camera lucida. It includes details from Flinders’ journal of time spent in Western Australia, Port Phillip and the coast of Queensland, which brings to life the work Bauer undertook on these journeys. Interspersed are images that take one’s breath away, such as the painting of the Port Lincoln ringneck and delicate pencil drawings of a kangaroo and ringtail possum—not illustrated in the formal way of the time, but in natural positions, as Bauer observed them. There is information in the captions as well as the text. For example, where a species was found, its history or uses, where the drawing or watercolour is published and where the original is held. This approach breaks the rules adhered to by most other books on the subject and provides user-friendly research information.

*Painting by Numbers* is a thick, quarto-size book. The quality of the paper, along with the layout and design and the pencil and colour reproductions, is immediately apparent. The images are arranged not only to fit with the text, but also to contrast with a previous illustration and play on the reader’s senses—first one, then another. The book is a great tribute to Bauer—the man Bernard Smith called ‘the Leonardo of natural history illustration’—and his character resonates through his art.

In several weeks I will be visiting Vienna and now that I've read *Painting by Numbers* my overriding desire is to see some of these original drawings now held in that city's Naturhistorisches Museum.

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**Danielle Clode:** *The Wasp and the Orchid: the Remarkable Life of Australian Naturalist Edith Coleman*. Pan Macmillan Australia: Sydney, 2018. 420 pp., illus., ISBN: 9781760554286 (HB), \$39.99.

Danielle Clode's biography of Edith Coleman has received a substantial number of reviews since its publication, and most reflect positively on the multi-layered aspect of the work. It is at once the rediscovery of a neglected nature

writer who illuminated the phenomenon of pseudo-copulation in orchids, and a life-affirming narrative of the rise into prominence of an unpretentious heroine of Australian nature. Moreover, Clode's consideration of why Coleman's story has not been told before takes her into the realms of sexism in history, both in acknowledging the limitations that past societies have placed on what women may do or say, and also in the ongoing inclination of historians to focus on the achievements of men.

The challenges faced by Clode in writing a biography of Coleman are familiar ones to the authors of female scientific biography. Coleman achieved prominence in one aspect of her life (as a naturalist and nature writer) and for one period of her career (in mid to late life) and this is where the richest records about her are to be found. Details about the rest of Coleman's life remain patchy at best. It is this dimension of Clode's biography that most attracted my attention, as I looked for inspiration on to how to tackle similar issues in writing about Ferdinand von Mueller's female botanical collectors in the second half of the nineteenth century.

Several strategies have been employed by would-be biographers of scientific women. These include resorting to fiction to imaginatively recreate the missing chapters of a woman's life, attempting to 'read against the grain' of surviving documents to reveal hidden truths, or deciding to avoid biography and focus on the aspects of a woman's life that are substantially documented.

While sampling several of these methods, notably 'reading against the grain', Clode adopts yet another strategy to overcome Coleman's uneven historical record. She adds herself to the story, as a companion to the reader in the discovery of the surviving details of Coleman's life and in interpreting their significance. In this way we are able to enter into the triumphs and frustrations of writing female scientific biography, with the added bonus of getting to know Coleman's sensitive and likeable biographer.

The foregrounding of the authorial self is not without its pitfalls. It can pull focus from the main subject of a biography, and lay bare

the influence of an author's personal preoccupations in interpreting historical documents. *The Wasp and the Orchid* manages to walk this precarious path with grace and humility, and I think there is an intellectual honesty in Clode being prepared to place herself under the microscope as well as her biographical subject.

Like Coleman, Clode had to overcome familial and societal expectations to bring the study of nature into the centre of her life. In addition, they are both nature writers, and it is Clode's insightful analysis of this area of Coleman's life that I found most illuminating. They both champion a style of nature writing that focuses on what is being observed rather than on the observer (although this is not without its frustrations for a biographer). The extracts that Clode gives us of Coleman's congenial prose are such as to make me hope she will consider publishing an edited selection of Coleman's writings.

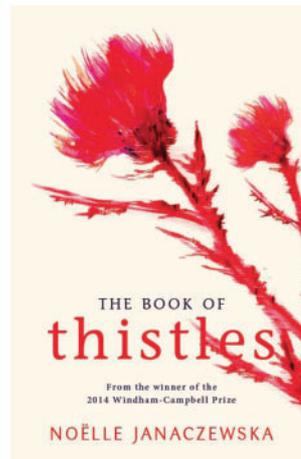
There are, however, important differences between author and subject in the *Wasp and the Orchid*. Clode and Coleman come from different generations, and while Coleman found nourishment for her naturalist's inclination in so-called amateur groups such as the Field Naturalists' Club of Victoria, Clode was able to enjoy the benefits of a university education. As a consequence, Clode is able to reflect on the significance of Coleman's writings in an era where we have seen a diminution of the bush habitat that Coleman wrote about in Blackburn in Melbourne. Clode is also able to draw in current preoccupations with a loss of biodiversity and climate change.

Readers of *Historical Records of Australian Science* will find much to enjoy in the *Wasp and the Orchid*, not least the story of the wasp and the orchid. The book is a pleasure to read and to look at, with great care taken in layout and choice of images. Clode has a substantial track record in writing about science and she brings this experience to bear in her biography of Coleman, while at the same time breaking new ground in the way in which she has researched and framed her subject.

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**Noëlle Janaczevska:**

*The Book of Thistles*.  
UWA Publishing: Crawley,  
2017. 250 pp. ISBN:  
9781742588049 (PB), \$24.99.



In her introduction, Noëlle Janaczevska admits to a love of books from the eighteenth and nineteenth centuries, where musings on theology and literature might sit side-by-side with gardening hints. *The Book of Thistles* boasts a similar miscellany.

Playful, poetic and philosophical in turn, Janaczevska's work cuts across expectations of a systematic investigation or a single narrative. Historical newspaper extracts are layered with botanical information, food writing and personal memoir. Although they are stitched together with an associative thread that at times seems slender, the author amply fulfils her aim of placing the humble thistle—a family that consists of hundreds of different species—on centre stage.

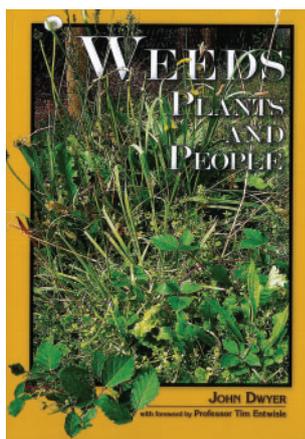
The book is divided into five thematic sections: Names, Law, War, Food and Outliers. In the section entitled Law, for instance, Janaczewska explores the thistle's outlaw reputation, the 'thistle panic' that gripped Australian settlers in the nineteenth century and the imaginative possibilities that its status as a 'weed' presents. She also proposes a deep-seated anxiety in the Australian settler psyche that remains hyper-alert to villains and threats.

Interspersed through other sections, Janaczewska probes her own sense of connection with thistles, drawing parallels between the migrant experience and the colonial relocations of these plants that have often flourished almost beyond recognition in adopted homelands. Language clearly fascinates the author; the subjective judgements surrounding thistles are grist for her mill. A thistle can be both the 'terrorist of the plant world', reviled and legislated against, and yet—in a different context—valued for its medicinal or culinary qualities.

The inclusion of imagined historical scenes and dialogue not only reflects Janaczewska's training as a playwright and interest in the performative voice, but also her willingness to ask questions of the past and ponder how history is constructed. 'Imagination animates the past', Janaczewska writes, 'sometimes it's the only way to engage with what might have happened'.

Multi-faceted and multi-layered, *The Book of Thistles* offers the reader a stimulating, sometimes disconcerting, meditation on the diverse meanings and resonances that adhere to our human interactions with thistles. Environmental historians researching the cultural and social meanings that attach to non-human nature may find this book of interest, but its movement across manifold genres and narrative points of view means its main appeal will be to admirers of experimental writing and literature.

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**John Dwyer:** *Weeds, Plants and People*. PenFolk Publishing: Blackburn, 2016. 293 + xv., illus., ISBN: 9780958699372 (PB), \$44.95.

'When a tree is called a weed, the chainsaw is not far away', so writes John Dwyer in this erudite and engaging plea for a wider understanding of plants that are called weeds. It helps the reader to know that the author is a QC with a long career in law who was awarded a doctorate in 2007 for

his thesis on weeds in Victoria. This book, *Weeds, Plants and People* is the detailed case he makes against the defamation of certain plants by scientists, bureaucracies and chemical companies who trumpet 'wars on weeds'. The book is no ranting polemic. It is a rich account of people's use of—and reactions to—a variety of interesting plants.

Weed science emerged as a distinct domain from the early 1950s, but Dwyer forensically reveals that it could produce no satisfactory definition of what a 'weed' is. He considers that the term has 'no

essential core of meaning' and is thus perennially subjective. Having set weeds up as historically and spatially contingent in the first chapter, he assembles a range of information about weeds in the Bible and ancient times over the next two chapters. The author traces the idea of weeds—arising when plants started to become agricultural crops—and he examines the diet of people 2000 years ago whose bodies have been preserved in bogs. Dwyer then advances his argument for a wider understanding of plants and people by a detailed examination of twenty-seven 'witnesses'.

His first thirteen examples are plants that are both food and weeds to different people at different times. Fat Hen—also known as Lamb's Quarters or White Goosefoot (*Chenopodium album* L.)—caught my attention. I once hand-weeded it in British potato fields, never knowing that its leaves and seeds had for centuries been used as food, as they still are in some countries. Dwyer provides a wealth of social and botanical information about Fat Hen, illustrated by a herbarium specimen collected by Ferdinand von Mueller.

The next eleven are plants that are both medicines and weeds, having been found in human remains and archaeological investigations. Black Nightshade (sometimes disastrously confused with Deadly Nightshade), Buttercups, Chickweed and Dock will be well known to many readers, and the bright European Corn Poppy (*Papaver rhoeas* L.) is the sad reminder of Flanders fields each Remembrance Day. Dwyer takes his history of poppy seeds back to Egypt in 2500 BC, Homer's *Iliad*, the poetry of Ruskin and Pope, the first gardening book, Monet's painting and Mueller's herbarium specimen. He reports that the seeds have been used as a mild sedative; we all know their popularity in bread and cakes. Nevertheless, the Corn Poppy escaped from gardens and is called a weed across Australia. As weed, food or medicine, the evidence of the poppy and Dwyer's other 'witnesses' show that these attributes often overlap.

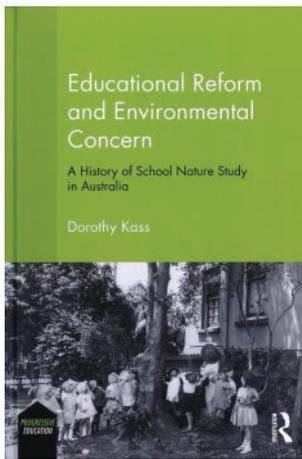
Three plants, Plantain, Radish and Nutgrass, are each given longer consideration in individual chapters. Dwyer covers five of the two hundred species of the Plantain genus, *Plantago*, reporting that two of them, *P. major* and *P. lanceolate*, are two of the world's worst weeds for their ability to colonize pasture. Plantain was already established in Sydney within fifteen years of European settlement, probably as a fodder plant, and has spread across the continent since. It has old medicinal uses, while its leaves have been used for salad and *P. psyllium* powder is now available in health-food shops. The chapter on Nutgrass, a particularly pesky weed in my Canberra garden, caught my attention. There are different species that have been used as food, medicine and perfume since prehistory. Botanists are not sure whether it is a native Australian plant and which species were eaten by Aboriginal people. It has also been listed as one of the world's worst weeds.

Having presented this rich evidence, Dwyer titles his last chapter 'Time for a truce in the war on weeds'. He never denies that plants can be troublesome—some terribly so in Australia—but argues against using the militaristic metaphors of 'war', 'invasion' and so forth that have become propaganda in the mouths of both chemical companies and environmentalists. He briefly cites problems with herbicides, ranging from their use in the war in Vietnam and Cambodia, to drift from aerial spraying. In calling for a truce, Dwyer writes that 'it would be better to stop being frightened of weeds and seek a more peaceful co-existence'.

This very civilised book should find many readers among historians of science, environmental historians, gardeners, archaeologists

and others. For the views of soldiers, agronomists and economists, readers should look elsewhere, but everyone will look at ‘weeds’ differently after reading *Weeds, Plants and People*.

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**Dorothy Kass:** *Educational Reform and Environmental Concern: a History of School Nature Study in Australia*. Routledge: Oxford and New York, 2018. 217 +xvi pp., illus., ISBN: 9781138650510 (HB), \$63.00.

In a charming image on the cover of this book, a group of young children are ranged in a semi-circle around a tree in the playground of Sydney’s Stanmore Public School. A few break ranks, crowding eagerly about the trunk.

It is a sunny day in 1919—Spring perhaps—and the children are looking for birds’ nests. Standing at the back, the teacher points to the canopy, and her students peer upwards, clearly absorbed.

Showcased within this image are some of the child-centred teaching strategies associated with the school subject, nature study. The teacher has arranged conditions for learning and students acquire knowledge and skills for themselves through direct experience of nature. Back in the classroom, they might discuss their experience, write about it, draw pictures, or read relevant nature stories. These were methodologies associated with progressive or ‘New Education’, which gathered transnational support towards the end of the long nineteenth century. Nature study, Dorothy Kass tells us, was a signature subject.

Taught in United States elementary schools from the early 1890s, then adopted by school systems elsewhere, nature study entered the primary school curriculum in every Australian state between 1900 and 1914. New South Wales (NSW) introduced it in 1904. It was intended to develop skills in observation and logical thinking and, taught well, children acquired some ecological understanding. However, nature study was more than elementary science. It also sought to foster in young children an aesthetic appreciation of nature and an imaginative empathy with the natural world, eliciting their desire to care for it. This strong conservation ethic reflected growing disquiet among the subject’s proponents concerning species extinction, landscape degradation and a perceived rift between humanity and nature. The link between nature study and environmental concern is central to this book.

Number three in the Routledge series, *Progressive Education: Policy, Politics and Practice*, Kass’ book is both timely and important. The history of school nature study in America is well served by the work of Kevin C. Armitage (2009) and Sally Gregory Kohlstedt (2010), but save for a 1997 article by Kohlstedt, discussion of nature study in Australia has been left to a handful of general education histories and some recent work by environmental historians.

Among the latter, Libby Robin has explored nature study’s connection with environmental concern, but largely in relation to Victoria. Kass’ case-study of nature study in NSW thus adds substantially to the history of this aspect of progressive educational reform in Australia, and it also enriches environmental history.

Valuable insights are delivered along the way. Kass distils the key elements of nature study as understood by its American advocates, while noting some variation in emphasis—conservationist, preservationist, secular, religious or rural. Australian educators are shown to have drawn on American ideas, but Kass overturns conventional notions of Australian passivity in this transnational intellectual exchange. Rather, she argues, educators in NSW adapted received ideas to local conditions and concerns, and shared their innovations with interested overseas educators via personal correspondence, publications and the hosting of foreign visitors.

Numerous heroes emerge from her account of nature study’s introduction and implementation. In the state’s centralized education system, Peter Board’s leadership as Director of Education was crucial. But others share the limelight: Alexander Hamilton, ecologically attuned botany lecturer at Sydney Teachers’ College; Hawkesbury Agricultural College’s inspiring botany and entomology instructor, Charles Musson; innovative teacher, Martha Simpson; and Amy Mack, author of children’s nature stories. Remarkable too seems the energy directed towards equipping teachers for curriculum change by school inspectors, teachers’ associations, tertiary institutions, and private publishers. Summer schools, conferences, lectures, training courses, official publications, newspapers and textbooks were all in the mix.

A chapter-long history of the environmental movement in NSW is illuminating in its own right. It also demonstrates the strong support that nature study received from conservation and preservation movements, for whom public education was a priority. Teachers, teacher trainers, and even the Chief Inspector are revealed as active members of such organizations, reinforcing the connection between school nature study and environmental concern.

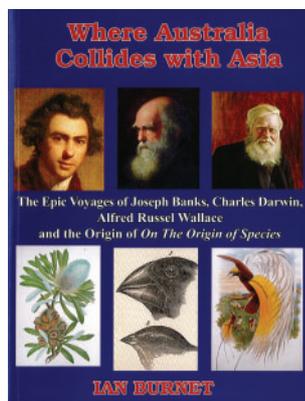
The discussion throughout is underpinned by a dazzling array of sources—from the theoretical and practical texts of nature study’s advocates in both hemispheres, to textbooks, stories, official publications, and archival sources, including photographs like that on the cover. Combined with the considered use of rare, surviving examples of pupils’ work, Kass succeeds admirably in ‘opening the classroom door’ to show that, despite some early resistance, nature study was largely well received. Moreover, its original broad focus on nature survived in practice despite an official emphasis on elementary agriculture during the 1920s and 1930s.

The term ‘nature study’ disappeared from the curriculum in 1952 but, as Kass demonstrates, the subject’s legacy was significant. She highlights its formative effect on leading twentieth-century environmentalists, such as Myles Dunphy, and by analysing successive syllabus and policy documents, Kass tracks nature study’s ongoing influence on the elementary science, which replaced it. Since 2010, however, science education has focused on sustainability, encouraging a more dispassionate approach to nature, and once again the call is heard for educational reform that would encourage greater intimacy between children and their natural environment.

Students, historians and anyone interested in the history of education or conservation should read this well-written book. The text,

dense with ideas and analysis, is augmented by lucid exposition, judicious signposting and helpful chapter summaries. Endnotes and a bibliography usefully follow each chapter, twenty suitably placed images support the argument and there is a comprehensive general index. Hopefully, some readers may be inspired to investigate school nature study's history in other Australian states, all distinct colonial nations before 1901. Kass locates her case-study broadly in its continental context, but given the states' separate histories and interests, a detailed, comparative study could well prove fruitful.

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**Ian Burnet:**

*Where Australia Collides with Asia: the Epic Voyages of Joseph Banks, Charles Darwin, Alfred Russel Wallace and the Origin of On The Origin of Species.* Rosenberg Publishing, Sydney: 2017. 206 pp., illus., ISBN: 9780994562784 (PB), \$34.95.

The title of this book leads the reader to believe that it will explain why the Lombok Strait

and the Wallace Line hold such a significant place in the formulation of the theory of evolution. In this sense, it is partly successful.

Ian Burnet, with thirty years' personal experience in the culture and history of the area, gives competent, intelligent and entertaining accounts of the voyages of the three main protagonists whose discoveries transformed our understanding of the processes of evolution and species formation. Specifically, he discusses Joseph Banks, Charles Darwin and Alfred Russel Wallace, after whom the Wallace Line is named. The book is superbly illustrated with eighteenth- and nineteenth-century paintings, etchings, drawing and maps, some of which hail from the diaries of the voyagers. It also features modern photographs of animals, birds and locations. Extracts from Banks', Darwin's and Wallace's diaries and books also form a substantial part of the narrative and are used to great effect by Burnet to enhance and illustrate his story.

Burnet is not covering new ground here. The subject has been explored before—and perhaps more thoroughly—by Iain McCalman's *Darwin's Armada* (2009) and, to a lesser extent, by Sean Carroll's *Remarkable Creatures* (2009). Banks' journey has been ably described in Peter Aughton's *Endeavour*, an account of James Cook's first voyage in 1768. *Where Australia Collides with Asia* is competent, well written and engaging, but at the end I was left feeling that something was missing.

The book presents an entertaining historical travelogue. It comprises a series of descriptions of the three explorers' voyages, outlining their struggles and the conclusions they were forced to contemplate. However, unless one reads the extract from Wallace's *Malay Archipelago* in the frontispiece, the reader will have to complete two-thirds of the book before learning what and where the Wallace Line is. Considering that this biogeographical distinction

marks the collision between Australia and Asia—as foregrounded in the title—this is a confusing structural flaw.

The reader will furthermore be left wondering why this is such an important place in the history of formulating the theory of evolution. What is missing is the analysis of how the voyagers' observations caused them to come to the conclusions they did, and which were to shake the very ground upon which their civilization had been built.

Burnet details the when, where and how—but not the why. Why were the observations made in this place so significant? He describes the differences in the suite of species either side of 'the line', and concentrates on the people involved. He does not, however, give enough weight to the significance of the locations he describes in Darwin's formulation of natural selection theory, nor his ideas on the origin of new species.

The point is simply not emphasized enough that the discoveries made in this region proved that species had changed over unimaginable periods of time and were not 'immutable', as promulgated by religious and scientific orthodoxy. The three explorers' observations gave Darwin and Wallace the evidence for a mechanism that drives evolution—continental drift, or plate tectonics as it is now known. The discovery helped to change humankind's view of the earth and our place among the species upon it.

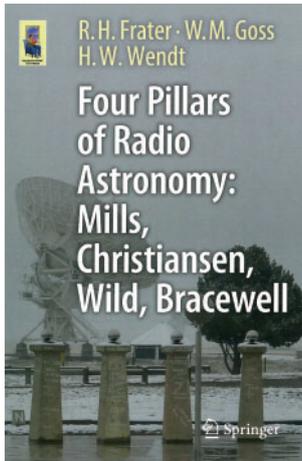
This lack of emphasis is surprising considering that Burnet has a degree in geology, and is clearly an expert on the locality. The book conveys his wealth of knowledge about the peoples of the Indonesian archipelago, including their history and culture. The text, however, is not entirely successful in articulating the connection between the geology and biology of the region, especially the discovery of evidence of one of the key mechanisms by which populations are separated and new species evolve. As a result, the narrative does not fully account for the area's importance in Darwin's development of the theory of evolution, which in turn drove him to write *On the Origin of Species*.

The book's style is somewhat journalistic, giving us 'just the facts'. Considering his knowledge of this part of the world, it is a shame that the author did not enlist his own experiences to influence the narrative, by allowing the reader to see the area through an explorer's or scientist's eyes. While he does a very good job of telling the reader what happened, showing us a little more would, perhaps, have enhanced the tale.

However, this remains a very good book. It has been thoroughly researched and contains a useful bibliography enticing readers to pursue the subject further. It is well written, informative and engaging, all of which are essential in a work aimed at a general audience. I found much to admire and to keep me reading without effort. The quotations have been well chosen and enhance the narrative. The characters of Darwin, Wallace and Banks are fleshed out nicely and their stories are presented in a sensible chronological order.

I can see how Burnet's account could encourage anyone interested in evolution, exploration or natural history to read Darwin's *Voyage of the Beagle* and the two volumes of Wallace's *Malay Archipelago* for themselves. In this sense, Burnet has done a very good job indeed.

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**R. H. Frater, W. M. Goss and H. W. Wendt:** *Four Pillars of Radio Astronomy: Mills, Christiansen, Wild, Bracewell.* Springer: Cham, 2017. 199 + xv pp., illus., ISBN: 9783319655987 (PB), €29.99.

The rapid development of radio astronomy in the late 1940s and 1950s at CSIRO's Radiophysics Laboratory in Sydney is one of the most exciting chapters in the history of Australian science. It is also one of the most intensely studied, prompting several recent

books, journal articles and PhD theses. This book—presenting brief biographies of four of the early pioneers of Australian radio astronomy—is a welcome and worthy addition to this growing body of work.

The common thread to the book is that all four 'pillars' joined the Radiophysics Laboratory in the 1940s, going on through the 1950s to become world leaders in their chosen branch of radio astronomy. The three authors are certainly well qualified: Bob Frater is a former chief of the Radiophysics Laboratory; Miller Goss is a leading American radio astronomer; and Harry Wendt is a historian of Australian radio astronomy. All three have been co-authors of the official memoirs of the four pillars (Mills, Christiansen and Wild were Fellows of the Australian Academy of Science); indeed, Frater was a co-author on all four memoirs.

The opening chapter sets the scene by describing the discovery of radio waves from space by the Americans Karl Jansky and Grote Reber in the 1930s. The Radiophysics Laboratory itself was founded in 1940 to carry out secret wartime research on radar. After 1945 the Laboratory decided to re-orientate its research program into peacetime applications of radio and radar. Under the leadership of Joe Pawsey, radio astronomy proved to be the wild card in the pack.

A chapter is then devoted to each of the four pillars. Bernie Mills is best known for his invention of the cross-type instrument that now bears his name. The cross proved particularly effective for discovering galactic and extragalactic radio sources. In the mid-1950s Mills was at the centre of the controversy between supporters of the rival 'big bang' and 'steady-state' theories on the origin of the Universe. A radio astronomy group in Cambridge claimed their observations provided strong evidence in favour of the big bang, whereas Mills' observations of the southern skies showed no such evidence. Eventually the Cambridge survey was shown to be corrupted by an instrumental effect known as 'confusion' and the Cambridge claim was discredited.

Chris Christiansen specialized in radio studies of the Sun. He designed array-type telescopes to produce high-resolution images of the solar disk and he pioneered a technique known as earth rotational synthesis, which became the basis of modern synthesis radio telescopes. Christiansen was prominent in promoting the international development of radio astronomy, serving as vice-president of the International Astronomical Union and as president of the International Union of Radio Science.

In 1960, both Mills and Christiansen left CSIRO under controversial circumstances and founded a radio astronomy group at the University of Sydney, one that would soon rival the Radiophysics Laboratory. In contrast, Paul Wild spent his entire career in CSIRO, becoming the Radiophysics chief in 1971 and then CSIRO chairman in 1978. Wild invented an instrument known as a radio heliograph for studying transient phenomena on the Sun, such as violent flares in the solar atmosphere. His classification of these phenomena is still in use today.

After joining the Radiophysics Laboratory in 1949, Ron Bracewell worked with Joe Pawsey to co-author *Radio Astronomy*, the first scholarly text on the subject. In 1955, Bracewell was appointed professor of electrical engineering at Stanford University. He is best remembered for his development of the mathematical techniques used to form images from radio observations, techniques that remain the foundation of all radio astronomy imaging today. Although primarily a theorist, Bracewell designed and built the Stanford Microwave Spectroheliograph for solar studies. The instrument consisted of 32 dishes, each mounted on a pier or pillar, which has provided the inspiration for the title of this book and the photo on the front cover.

Each of the four biographical chapters begins with an account of the subject's early life and how he became a radio astronomer. The focus then moves to the development of their professional careers. This discussion becomes quite technical in parts, which a general reader will be tempted to skip over. Personally, I would have liked more about their interests and activities outside of their professional circles, which might have added more 'colour' to Mills, Christiansen, Wild and Bracewell as individuals.

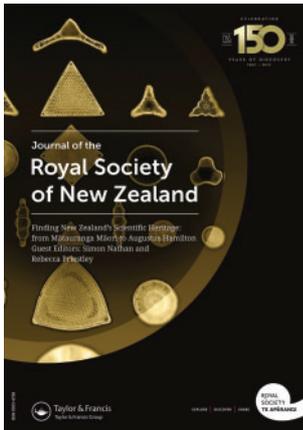
The final chapter discusses the influence of the four pillars on the development of radio astronomy. As Ron Ekers notes in his Foreword: 'The *Four Pillars* started an unbroken line of instrumental developments in which Australia has continued to play a global role. They sowed the seeds that have now led to Australia's involvement in the Square Kilometre Array—a major astronomical project with the Murchison Widefield Array and the Australian Square Kilometre Array Pathfinder as its precursors'.

Also discussed is the wider influence of the four pillars beyond radio astronomy. A notable example is medical imaging: Bracewell's mathematical theories underpin the technique of computer-aided tomography (CAT scans). Another better-known example is the development of Wi-Fi by a group at CSIRO Astronomy and Space Science (the modern-day Radiophysics Laboratory). Three of the five members of this group were products of Christiansen's department at the University of Sydney.

Although relatively short, the book contains well over 100 images (some in colour), making the presentation visually attractive. To my knowledge, more than half the images are previously unpublished. Most of them are drawn from the Radio Astronomy Image Archive managed by CSIRO in Sydney.

One drawback is that the book fails to cite several relevant references. They include publications by the astronomy historians Wayne Orchiston and Ron Stewart and, curiously, publications by the book's co-author, Harry Wendt. Despite these missing references, *Four Pillars of Radio Astronomy* should be on the shelves of anyone interested in the rich and remarkable story of Australian radio astronomy.

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**Simon Nathan and Rebecca Priestley:** *Finding New Zealand's Scientific Heritage: from Mātauranga Māori to Augustus Hamilton.* *Journal of the Royal Society of New Zealand* 47, no. 2 (March 2017): 1–144.

Much has been written about the three big names of nineteenth-century science in New Zealand—Ferdinand Hochstetter, Julius Haast and James Hector—all of whom were geologists. It is therefore welcome to have a series of essays

published that cover wider scientific disciplines, and provide information on the work of other practitioners who were involved in science to a lesser or greater extent in New Zealand in the nineteenth century. These 21 short essays with appropriate references resulted from a conference on the history of New Zealand science held in Wellington in November 2015 to celebrate the 150th anniversary of the appointment of James Hector as New Zealand's first government scientist.

The essays cover a wide range of topics. The New Zealand Institute (later Royal Society of New Zealand), so important as a focus for New Zealand science, its affiliates and publications are well described. Importantly, the essays also explain the support from government that the Institute received from the many well-educated politicians who were members. Collections and outreach to the public are covered by essays that touch on museums in Otago, Wellington, Hamilton, Hawkes Bay and Auckland, including the involvement of James Hector, T. J. Parker, Thomas Cheeseman, Augustus Hamilton and Walter Mantell. Other individuals who made a precarious living as scientists are dealt with in essays on Henry Suter (palaeontologist), William Grayling (chemist) and Thomas Kirk (botanist).

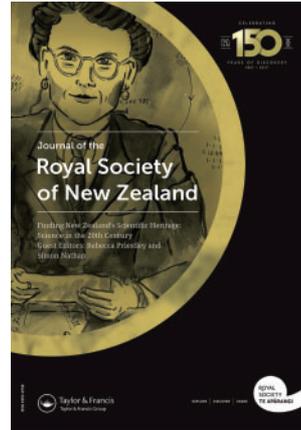
The subjects of astronomical and geophysical observatories, including time keeping, are covered in three essays on the work of James Hector, S. J. Carkeek, Arthur Stock and J. T. Thomson. One essay deals with the effects of the 1848 Wellington earthquake and its later influence on building construction.

Māori involvement in science is also included in two essays; the first on Māori scientific knowledge of the world around them and the second on Māori concerns about conservation of the New Zealand environment based on surveys of nineteenth-century Māori newspapers.

Other contributions cover the visit of the *Challenger* Expedition to New Zealand in 1874; the extent and value for historical research of the Julius Haast collection held in the Alexander Turnbull Library; and the significance of the Oamaru diatomite.

This volume, with its extensive references in each article, is an excellent introduction for the reader who wishes to find out more about aspects of New Zealand's nineteenth-century science.

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**Rebecca Priestley and Simon Nathan:** *Finding New Zealand's Scientific Heritage: Science in the 20th Century.* *Journal of the Royal Society of New Zealand*, 47, no. 2 (June 2017): 145–217.

To celebrate the sesquicentenary of the Royal Society of New Zealand (originally founded as the New Zealand Institute in 1867), Rebecca Priestley and Simon Nathan have assembled two special issues of the *Journal of the Royal Society of New Zealand*.

The first covers the nineteenth century, and the second—the volume under review—considers the twentieth century. This collection contains eleven short essays with an introduction by the editors. Many of the contributors have been active participants in scientific work in New Zealand. As the editors note, the task of researching and writing the local history of science still falls mainly to scientists, rather than to trained historians.

The introduction is very brief and does not frame or conceptualize the collection as a whole. This is a disappointing way to open such a volume, as readers not familiar with the current state of the history of science in New Zealand, or its conceptual preoccupations, are not given a strong orientation. After this introduction, Kate Hannah's paper offers a robust critique of the continued absence of women from the story of New Zealand science. Hannah demonstrates how the conference that gave rise to this special issue saw only seven women mentioned in the abstracts, whereas 81 individual men were named.

The remaining ten essays cover a range of scientific disciplines and historical approaches. Anthony and Catherine Hodder give a detailed description of the built environment of scientific work in Wellington, including the buildings for the Museum, Colonial Laboratory, and Vaccine Station, all of which had disappeared from both the physical fabric and cultural memory of Wellington by the 1970s. Matthew Henry tells the story of the human-nonhuman assemblage for observing the upper atmosphere in Apia, Western Samoa, made by the American meteorologist Andrew Thompson in the early 1920s. Ross Galbreath gives a brief account of how scientists came to lead and control the Department of Scientific and Industrial Research (DSIR), in contrast to the administrator-led experience of its British progenitor department. Geoff Gregory briefly recounts the history and fortunes of the New Zealand Association of Scientists, noting its initial, excellent growth in membership, its history of interventions into New Zealand scientific and environmental policy, and then its more recent retreat into quiescence. Keith Lewis also surveys the early years of the New Zealand Oceanographic Institute.

There are five papers focused on individual scientists. Simon Nathan details the story of indefatigable geologist, Charles Edward Douglas, and his production of a substantial geological map of Westland. This depiction of the west coast of the South Island was itself lost and found on several occasions. There are three articles whose authors are the children of their subjects. Keith Willett writes on his father Richard, a significant geologist and director of the

New Zealand Geological Survey. Mary Harris discusses her mother, the radiophysicist Elizabeth Alexander, whose story is notable not only for her scientific contribution, but also the social and institutional barriers faced by a woman truly advancing her career in the 1940s. Finally, John Hearnshaw writes on his father Leslie, the first director of the Industrial Psychology Division of DSIR from 1942 to 1947, who strove to improve the conditions of New Zealanders working in factories engaged in war production. Finally, Josephine Reid recounts the life of the astronomer Beatrice Hill Tinsley, especially her battles to achieve a place in the world of university research.

This is a small collection on a range of interesting institutions and individuals. The papers are mostly descriptive, rather than analytical, and none of the contributors exhibit a particular concern to

engage with the larger body of history of science scholarship. One of the striking, if implicit, themes of the collection relates to place and the 'where' of science. Several papers contend that the history of science in New Zealand spills over its geographic boundaries, contributing to territoriality, imperialism, or globalisation, from the careers of Thompson in Apia and Tinsley in the USA, to Alexander in Singapore and Nigeria. While 'heritage' is a keyword in the collection's title, what remains ambiguous are the ways in which the history of New Zealand science can be enrolled—or perhaps even neglected—in moving science or the nation forward into the future.

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