MATHEMATICS IN AUSTRALASIA, TO 1900

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In memory of Garry Tee, 1932 – 2024

Abstract

This article introduces the first professors of mathematics in Australasia and discusses their contributions to the research fields of mathematics and statistics. There were many other nineteenth-century contributors, particularly government statisticians and registrars-general, whose work is also described. Journals of the Royal Societies in Australia and New Zealand and their predecessors are the main source of information, but a number of contributions in English journals have also been noted. In 1888, the first meeting of the Australasian Association for the Advancement of Science was held, and there were seven more meetings up to 1900; all mathematical papers presented at those meetings are recorded here.

Keywords

Australia, New Zealand, history, statistics, geometry, differential equations

Introduction

To write the history of mathematics in Australia and New Zealand, as it would be for other endeavours, scientific, cultural or sporting, is especially appealing because those two countries, and perhaps no others, are so young (since European settlement) that the histories can be given in comprehensive detail. Yet the countries are old enough that the history is now sufficiently broad and of such quality as to have significance for the rest of the world. Garry Tee, formerly of the University of Auckland, wrote that history for New Zealand, or would have if his writings had been combined into one volume, and I have written *Counting Australia In*, to account for mathematics in Australia to 2006, when the book was published. Of course, many others have written about aspects of those histories.

Here, much more simply, I confine myself to the nineteenth century and try to summarise mathematical personnel and achievements in Australia and New

Zealand under headings within mathematics. There is much more in *Counting Australia In* than I can include here, but research for this article has uncovered a number of items not previously described.

By the end of the nineteenth century, four universities had been established in Australia: the University of Sydney in 1852, the University of Melbourne in 1855, the University of Adelaide in 1876, and the University of Tasmania in 1893. In New Zealand, the University of Otago opened in 1871 and within a few years was incorporated into the University of New Zealand (though retaining its name as University of Otago). Besides the Otago campus, the University of New Zealand established colleges in Christchurch (Canterbury College, 1873), Auckland (1883) and Wellington (Victoria University College, 1897). The first few professors of mathematics or natural philosophy in these eight institutions are understandably the main source of the contributions to mathematics in Australasia in the nineteenth century, although those developments on the whole must be regarded as modest. There are as well a considerable number of books and journal publications of others that will be included as worthy of mention.

The term "Australasia", incidentally, was first used in 1756 and was adopted in the name of the first predecessor of the Royal Society of New South Wales, the Philosophical Society of Australasia, founded in 1821. New Guinea and certain Pacific islands are sometimes understood as also being part of Australasia, but any mathematics in those places before 1900 (such as discussions of counting systems used by the inhabitants) is not relevant to this article.

Mathematics of some academic merit in Australasia to 1900, for our purposes, was mostly published in the journals of the local Royal Societies and their predecessors, or in English or Irish journals, or in the reports of meetings of the Australasian Association for the Advancement of Science. Each of the six states in Australia (or colonies, as they were then) had a philosophical society (or such), and all of them, by 1913, had received royal assent, allowing them to be renamed a Royal Society. Each of these had a *Journal* or *Transactions* or *Proceedings* (or all of these). Details can be found in *Counting Australia In* (Cohen 2006) which will be referred to often here and which we will abbreviate as *CAI*.

In New Zealand, a number of research societies had been established by the 1860s, such as the Auckland Institute, the Wellington Philosophical Society, the Philosophical Institute of Canterbury, and the Otago Institute. Their activities were coordinated and assisted by the New Zealand Institute, founded in 1867. With the receipt of royal patronage in 1933, and the necessary government legislation, this was rebranded as the Royal Society of New Zealand. The *Transactions and Proceedings of the Royal Society of New Zealand* succeeded the correspondingly titled journal of the Institute, first published in 1869. Except for official purposes, the Society is known now, since 2007, as Royal Society Te Apārangi.

Of interest is that the New Zealand Institute was the successor to the New Zealand Society, begun in 1851 by Sir George Grey (1812 – 1898). He had previously been Governor of South Australia, from 1840 to 1845, and had founded the New Zealand Society during the first of two spells as Governor of New Zealand. In *CAI*, page 23, I wrote (with acknowledgement to Garry Tee):

> Throughout his life, Grey kept up a very strong interest in science, including mathematics. He studied quaternions at the age of 62 and, while premier of New Zealand [from 1877 to 1879], wrote extensive annotations in both volumes of Clerk Maxwell's *Treatise on Electricity and Magnetism*, published only shortly before in 1873. (Tee 1990)

Giving the developments in mathematics under headings which are subject areas within mathematics will lead to some overlapping, in that many mathematicians, with the classical training and applications of the day, can be placed in more than one area. For example, we will come later to Professor E. J. Nanson in the University of Melbourne. The English journal *The Messenger of Mathematics* divided its papers into a number of areas of mathematics. In Volume XXVI (May 1896 to April 1897), Nanson had two papers under "Geometry of two and three dimensions", one under "Differential and integral calculus", and one under "Applied mathematics". I will try to keep matters simple.

Contributions in Statistics and Actuarial Science

The first professor of mathematics in Australasia was appointed to that post in the University of Sydney in 1851. Morris Birkbeck Pell (1827 – 1879), then a Fellow of St John's College, Cambridge, and of the Cambridge Philosophical Society, arrived in Sydney in July 1852 and gave the university's first lecture in mathematics on 13 October at 10.00am that year. He developed an interest in life insurance and actuarial studies and most of his eleven papers are in these areas or the associated fields of demography and mortality. See, for example, Pell (1867). Pell is regarded as "the most important commentator on mortality in Australia before 1900" (Lancaster 1967). His work is described in *CAI*, pages 45 – 48, and by Lancaster and a number of other writers such as Salier (1932) and Seneta (1988).

In 1877, Pell was succeeded as professor of mathematics by Theodore Thomas Gurney (1849 – 1918). In his twenty-five years as professor, Gurney had a number of assistants. Notable among these was Elphinstone McMahon Moors (1859 – 1924), who was appointed assistant lecturer in 1887 and promoted to assistant professor in 1908. Having studied at Melbourne and Cambridge Universities, Moors gained a fellowship of the Institute of Actuaries around 1897 and subsequently introduced the subject Actuarial Mathematics and Statistics to Sydney University. He was recognised as devising "an entirely novel plan which came to be known as the unitary system of superannuation" for the New South Wales Civil Service in 1919. This "proved so successful as a pension scheme for

career services that the Commonwealth and all other States have since adopted the unitary system, and it is in operation in the United States and other parts of the world" (Moors 1960).

In New Zealand, Charles Edward Adams (1870 – 1945) was a prolific writer on mortality in his early career. He is described in one source as a "surveyor, astronomer and seismologist" and by himself in 1898 as "C. E. Adams, BSc, AIA, Engineering Scholar and Engineering Exhibitioner, Canterbury College, and Senior Scholar, New Zealand University; formerly Lecturer on Applied Mathematics, Canterbury Agricultural College" (Adams, C.E. 1898a). In this paper, he wrote:

> The first systematic investigation into New Zealand mortality, involving the results of more than one census, was made by F. W. Frankland, F.I.A., in 1883. The results of his investigation, which are deduced from the three censuses of 1874, 1878, and 1881, are given in vol. xv, of the 'Transactions of the New Zealand institute,' p. 500.

Of some relevance for the present article is Adams' note comparing general mortality in New Zealand, Victoria, New South Wales and England (Adams, C.E. 1898b). Adams' tables "fully bear out," he wrote, "that New Zealand is the healthiest place in the world."

In the *Dictionary of New Zealand Biography*, Warwick Smith wrote: "He [Adams] was awarded a DSc from the University of New Zealand in 1915 for a thesis entitled 'Harmonic analysis of tidal observations and predictions of tides' … It was Adams's work in astronomy that identifies him as one of New Zealand's important scientists" (Smith 1996).

Frederick William Frankland (1854 – 1916), mentioned in Adams' quote above, was New Zealand's Government Actuary from 1878 to 1889. Garry Tee wrote: "He belonged to many mathematical, statistical, actuarial and scientific societies, and he published articles and pamphlets on a bewildering variety of topics" (Tee 2002).

The second professor of mathematics in the Auckland University College (after William Steadman Aldis, see later) was Hugh William Segar (1868 – 1954). After studies at Trinity College, Cambridge, he came to the chair at Auckland in 1894. Segar had about fifteen papers on algebraic topics, mostly in *The Messenger of Mathematics*, before leaving England, and then many more after 1900 in New Zealand. The latter were all in the *Transactions* of the New Zealand Institute and nearly all concerned population or trade statistics. See the detailed obituary (Segar 1954-55) listing all of Segar's publications.

Other extensive statistical summaries for both countries, based for example on census, agricultural, meteorological and trade data, were the responsibility of government. Nineteenth-century registrars-general and government statisticians

in the six Australian colonies have their work described in *CAI*, pages 35 – 37 and 80 – 84, and in Forster and Hazlehurst (1988), Heyde (1988) and Cohen (2020a). Special among these was the first Australian Commonwealth Statistician, George Handley Knibbs (1858 – 1929). He was appointed to that post in 1906 and is described in brief biographies as a statistician, but, as Heyde (1988) points out, his many contributions to the *Journal and Proceedings of the Royal Society of New South Wales* and other prominent journals included results in fluid mechanics, theory of probable errors, astronomy and non-Euclidean geometry. See Knibbs (1897, 1899), for example, which were written while he was a lecturer in surveying at Sydney University.

Also worthy of special mention is the first registrar-general in New South Wales, Christopher Rolleston (1817 – 1888), appointed in 1855. By all accounts, he was very capable in the job as were his successors, but I single him out because of his paper "Science of statistics" (Rolleston 1858), which is recommended reading. It begins:

> The collection and comparison of facts which illustrate the condition of mankind and tend to develop the principles by which the progress of society is determined, form a science which has attained very great importance, both in society and legislation …

The first government statistician in New Zealand, William Marcus Wright, was appointed in 1910. Statistical publications there from 1840 are available at the Stats NZ Store House, https://cdm20045.contentdm.oclc.org/digital/collection/-p20045coll11/id/0/rec/2. See also Roberts (~1999).

In all of these statistical surveys, quantitative arguments were generally made only in terms of comparisons between complete tables of data, with little in the way of summary statistics. Other contributions to the discipline of statistics are described in some detail by Seneta (1988). He wrote of the work of Erastus Lyman de Forest (1834 – 1888) in Melbourne in the 1850s and his study of what became known as Sheppard's corrections for grouped data, and of William Stanley Jevons (1835 – 1882) on economic statistics. Jevons' meteorological analyses in both Australia and New Zealand are described also by Tee (2002).

An interesting example of curve fitting, just a few years before the invention of goodness-of-fit tests, was given in the paper Sutherland (1895). Alexander Sutherland (1852 – 1902) was a Melbourne polymath who taught mathematics at one time and later gained recognition as a historian and scientist.

Contributions in Geometry

Euclidean geometry, dating from the third century BC, remains today as the basis of school geometry, but from those times has been challenged as the most logical descriptor of the physical world. In the eighteenth and nineteenth centuries alternative geometries, denying one of Euclid's axioms, were promulgated by a number of authors, such as, famously, Johann Carl Friedrich Gauss (1777 – 1855), Nikolai Ivanovich Lobachevsky (1792 – 1856) and Janos Bolyai (1802 – 1860). A number of early New Zealand mathematicians engaged in a discussion of these concepts.

On this, the first relevant publication in New Zealand was that of Frederick Frankland, who is mentioned above in connection with Charles Edward Adams. His opening paragraph was:

> Among the remarkable speculations of the present [nineteenth] century is the speculation that the axioms of geometry may be only approximately true, and that the actual properties of space may be somewhat different from those which we are in the habit of ascribing to it. It was Lobatchewsky [*sic*] who first worked out the conception of a space in which some of the ordinary laws of geometry should no longer hold good. (Frankland 1876)

Frankland's article led to contributions by William Skey (1880), Frankland again (1885) and then the seismologist George Hogben (1886). Skey (1835 – 1900) was at one time Analyst to the Geological Survey of New Zealand, and was a noted petrologist, chemist and poet. Hogben is better introduced below.

The teaching of Euclidean geometry itself had its critics, such as James Henry Adams (1839 – 1906). Born in Ireland, he became a prominent headmaster of Thames High School in Waikato, New Zealand. See Adams, J. (1876). Papers by Daniel Brent (1870, 1871), who is not otherwise identifiable, also show familiarity with European developments in the teaching of geometry.

In Australia, there were well-received articles in classical geometry by Martin Gardiner (1833 – 1899). I have written of him elsewhere, in (*CAI*, page 75) and Cohen (2020a, 2020b). He was born in Dublin, studied civil engineering for just two years in Queen's College, Galway, and then spent four years in Canada. He came to Melbourne in December 1856 and worked mainly as a surveyor. By June 1859, he had been elected to membership of the Philosophical Institute of Victoria and had his first publication in its *Transactions*.

There were to be ten or so papers by Gardiner in the *Transactions* of the Royal Societies of New South Wales and Victoria, and four in eminent English journals. All are listed in Cohen (2020b). Five include deep aspects of trigonometry applied to surveying and geodesy. Others, the four in England in particular, deal with

Gardiner's most important work, namely, generalisations of the Cramer–Castillon problem on a construction involving straight lines and circles. See Gardiner (1866). It is notable that Gardiner undertook no formal study after his two years in Galway but he built and maintained a network of British and Irish mathematicians with whom he corresponded and exchanged results. For example, with regard to the paper Gardiner (1866), Richard Townsend, the eminent geometer and professor of natural philosophy at Trinity College, Dublin, wrote to Gardiner in 1865: "I can assure you I have not for a long time enjoyed a greater treat or experienced more pleasure than its study has afforded me. You need not ask me, my dear sir, to help to rescue your papers from obscurity — that paper will immortalise your name and hand it down to history, as that of a pure geometer of the first order." We can say now that Townsend was over-optimistic in his exuberance.

I wrote an embellished biography of Gardiner in Cohen (2022).

Another geometer of this period was the Frenchman Gaston Fleuri. Little is known of him besides the item in the University of Sydney *Calendar* for 1894 listing him as a temporary replacement for E. M. Moors, who was ill. In the *Calendar*, he is "Mr. G. Fleuri, B.Sc.", but in Fleuri (1892, 1894) he described himself as "G. Fleuri, Licencié ès-sciences mathematiques and Licencié ès-sciences physiques".

Somewhat earlier, in Victoria, there was a paper (Wilkie 1860) by the physician and legislator David Elliot Wilkie (1815 – 1885), who confessed that he "has devoted very little time to mathematical studies".

Contributions in Applied Mathematics (excluding differential equations)

The interests of Morris Pell at the University of Sydney extended beyond his actuarial work. In the highly mathematical paper "On the constitution of matter" (Pell 1871), he concluded:

> It is a curious subject for reflection, that the possibility of cosmos evolving out of chaos; that is, the possibility that the material universe should become fitted to be the abode of organic life, may have depended upon whether or not a few constants were so arranged, in the beginning, as to satisfy a simple mathematical condition.

Perhaps this should rank with statements and theories of the subsequent hundred years that described the habitable or "Goldilocks" zone in which the earth lies.

The paper by Knibbs (1897) (see above) should also be referenced in this section. See also the related paper by Barraclough and Strickland (1897).

In the University of Melbourne, the first professor of mathematics "(pure and mixed)" was William Parkinson Wilson (1826? – 1874). A graduate of St John's College, Cambridge, he had, in 1849, been appointed the first professor of mathematics in Queen's College, Belfast. Within a year, he produced his book, *A*

Treatise on Dynamics (Wilson 1850), which became a prescribed textbook for many years in Melbourne. The Preface to the book promises later volumes: "higher investigations, and the application of the principles to physical Astronomy … and determining the attraction and mean density of the earth." But it appears that no further parts were published and subsequently Wilson had only a few publications, such as Wilson (1856, 1858-1859), in the journals of the Royal Society of Victoria and its predecessor. In Belfast, he had founded and directed an observatory, and astronomy remained his abiding interest in Melbourne.

Wilson had two students of special note, Henry Martyn Andrew (1845 – 1888) and William Charles Kernot (1845 – 1909). Both excelled in their mathematical studies in Melbourne. Andrew was born in England and came to Melbourne in 1857. He returned for further studies in Cambridge, and held numerous prestigious positions in both countries, ending as the first professor of natural philosophy in Melbourne University in 1882. Kernot was also born in England; he pioneered engineering studies in Melbourne and, alongside Andrew, was appointed the first professor of engineering in Melbourne University in 1882.

After Wilson's death, the acting professor of mathematics for six months was Frederick Joy Pirani (1850 – 1881). He came to Australia from England in 1859 and studied under both Henry Andrew and William Kernot. With Andrew, Pirani wrote a school geometry text which was later expanded and went to many editions (Andrew and Pirani 1879). Pirani was followed as professor of mathematics by the permanent appointment of Edward John Nanson (1850 – 1936), who is discussed below.

John Henry Michell (1863 – 1940) succeeded Nanson in Melbourne. That was in 1923, but he began in the department as an "Independent Lecturer in Mixed Mathematics" in 1891 and within ten years had "cemented his reputation as a world leader in the fields of hydrodynamics and elasticity" (*CAI*, page 109). In that time, he wrote eighteen papers, culminating in his election as a Fellow of the Royal Society of London. Two of his most acclaimed papers are Michell (1890, 1898). Michell's brother, Anthony George Maldon Michell (1870 – 1959) was also known for his mathematical analysis of fluid motion and viscosity, which led to his also receiving an FRS.

The best two of the first few mathematical appointments to any university or college in Australasia, in terms of their subsequent standing, were both at the University of Adelaide. These were Horace Lamb (1849 – 1934) and the Nobel Prize winner William Henry Bragg (1862 – 1942).

Lamb was born near Manchester, England, and studied in Manchester and Cambridge, from where he applied successfully for the Adelaide post. He was there for its first lectures in mathematics, and is credited as well for instigating courses in natural philosophy. His first book, the famous *A Treatise on the*

Mathematical Theory of the Motion of Fluids (Lamb 1879), later expanded and (in 1892) retitled *Hydrodynamics*, was published in Cambridge while Lamb was in Adelaide. His paper (Lamb 1883) indicates the breadth of his work. Lamb returned to England, to a chair in Manchester, in 1885 and was prolific in the publication of articles and further books. He is particularly remembered also for his contributions to seismology, such as Lamb (1882), published from Adelaide. Keith Bullen, Australia's leading seismologist of the mid-20th century, wrote in regard to this paper:

> [It] is a classic in its completeness, and it recently rose to new prominence when free earth oscillations of the type Lamb had described were detected for the first time on records of the great Chilean earthquake of 1960. (Bullen 1973)

Regarding Bragg, in *CAI* (pages 63 – 67), I wrote that "Physicists always count Bragg among their own", but his initial appointment was certainly in mathematics alone. By 1899, but not before then, he was "Elder Professor of Mathematics and Physics". (Lamb was also "Elder Professor", named for the benefactor, Thomas Elder.) In fact, Bragg expressed disinterest in physics when first appointed, but that changed in the early 1890s. He was born in Cumberland, England, and returned to England, to Leeds, in 1908 as Cavendish Professor of Physics. With his son, William Lawrence Bragg, born in Adelaide in 1890, he won the Nobel prize for physics in 1915 for work in x-ray crystallography.

Clinton Coleridge Farr (1866 – 1943) was a student of both Lamb and Bragg. He tended to favour Bragg's physics, although it was Lamb who "communicated" his paper (Farr 1899) to the Royal Society of London. In 1911, he was appointed professor of physics at Canterbury College, Christchurch.

So far, I have introduced the first professors of mathematics in Sydney, Melbourne and Adelaide Universities. The only other university in Australia in the nineteenth century was the University of Tasmania, in Hobart. Its tortured development is described in *CAI*, pages 68 – 69. Alexander McAulay (1863 – 1931), born in Bedfordshire, England, and trained at Gonville and Caius College, Cambridge, was appointed to a lectureship in mathematics and physics at Ormond College in the University of Melbourne in 1888 and to a similar position in Hobart in 1892. Promotion to a full professorship came about in 1896, forestalling his interest in the chair in mathematics and mathematical physics being offered at Victoria University College in Wellington, New Zealand.

McAulay's text (McAulay 1898) on octonions, a generalisation of quaternions, indicated his enduring interest in quaternions which he saw as having applications in physics. There were other interests, though, as evidenced by his paper (McAulay 1892).

During 1900, McAulay was acting professor of mathematics in the University of Sydney while Theodore Gurney was on leave, and McAulay's place in Hobart

was taken for that year by Evelyn Granville Hogg (1863 – 1951). Hogg was lecturer in mathematics and physics at Trinity College in the University of Melbourne at the time, and later, for twenty-five years, was senior mathematics master at Christ's College, Christchurch, New Zealand.

Turning to New Zealand, the first professor of mathematics and natural philosophy at Canterbury College was Charles Henry Herbert Cook (1843 – 1910), appointed in 1874. Born in England and educated in Melbourne and Cambridge, at Christchurch he concentrated on his responsibilities as teacher and administrator for which he was highly regarded. Ernest Rutherford (1871 – 1937), the Nobel prize-winning physicist, was excessive in his praise of Cook as a teacher. For more on Cook, and what is now the University of Canterbury, see Everitt (2015).

Cook published very little, but his paper (Cook 1876) demonstrates his further interests. It begins as follows:

> It is not my intention to examine into the cause of the disaster which overtook the suspension bridge at the Brunner Gorge on the morning of the 28th July last [1876], but to call attention to the most noticeable peculiarity in its construction and to investigate mathematically the tension on the wire ropes which supported the bridge.

Having completed his analysis, Cook wrote: "I now wish to call attention to what appears to me to be serious defects in this bridge." The collapse of the bridge (on the north-west of the South Island) is well-documented, but Cook's contribution is not noted elsewhere, to my knowledge.

Also at Canterbury College, (Captain) Frederick Wollaston Hutton (1836 – 1905) was professor of biology from 1880. His interests extended beyond biology: he wrote on geology, zoology and mathematics, and was awarded the Clarke Medal of the Royal Society of New South Wales in 1891. The paper (Hutton 1869) is an interesting combination of mathematics and biology, but a critique by Joseph Sykes Webb (1832 – 1896), a zoologist, appeared in the immediately following paper. Hutton then responded to Webb in volume 4 of the same journal.

The first professor of mathematics in Auckland (in effect) was William Steadman Aldis (1839 – 1928). (An earlier appointee died soon after reaching New Zealand to take up the position.) Besides papers such as Aldis (1899), he wrote the following textbooks: *An Elementary Treatise on Solid Geometry* (1865); *A Chapter on Fresnel's Theory of Double Refraction* (1870); *An Elementary Treatise on Geometrical Optics* (1872); *Introductory Treatise on Rigid Dynamics* (1882); and *A Text Book of Algebra* (1887). Some of these went to many editions, and all are still available online for purchase.

This article does not document elementary mathematics (such as pre-school texts!) but *The Great Giant Arithmos, a Most Elementary Arithmetic* is an

exception. Written by Aldis' wife Mary Steadman Aldis in 1882 to introduce arithmetic to young children, it is still highly regarded and widely available. Mary Aldis (1838? – 1897) was a controversial social reformer.

Contributions to differential equations

The paper Aldis (1899), just referred to, certainly belongs under this heading.

Outside the universities in Australia and New Zealand, the most productive mathematicians were the surveyor/geometer Martin Gardiner, above, and the first Chief Justice of Queensland, Sir James Cockle (1819 – 1895). Cockle was born in Essex, England, and practised law for sixteen years before taking the post in Queensland, which he held from 1863 to 1878. He had published over fifty papers in mathematics before coming to Australia, and then 35 more while in Australia. Examples of his work are Cockle (1866, 1867, 1870). Cockle was president of the Queensland Philosophical Society for almost all of his time there, and president of the London Mathematical Society for a term on his return to England. His life is described in *CAI*, pages 74 – 75, and in more detail by Deakin (2002) and in many other sources.

Edward John Nanson was the second permanent professor of mathematics in the University of Melbourne, after William Parkinson Wilson. He was born in England and studied at Trinity College, Cambridge. He had many contributions, on a variety of topics, to *The Messenger of Mathematics*, as well as the paper Nanson (1876) on simultaneous partial differential equations.

Other contributions (voting systems, astronomy, seismology, surveying)

However, Nanson is best remembered for his work on "electoral reform", which itself is the title of one of a number of pamphlets he produced in the area. See also Nanson (1883). Nanson's work is still quoted, for example in McLean (1996).

William Parkinson Wilson's passion for astronomy has been mentioned. His paper Wilson (1856) was written shortly after his arrival in Melbourne, and, with continued advocacy by Wilson, the Royal Society in London agreed to have the telescope described in that paper established in Melbourne. It was operational from August 1869, and known as the Great Melbourne Telescope. In one form or another, it was functioning until 2003. See *CAI*, page 56.

The early astronomers in both Australia and New Zealand (and, no doubt, the later ones, too) were generally very capable mathematicians. Christian Carl Ludwig Rümker (1788 – 1862) was brought to Australia in 1821 by the newly appointed Governor of New South Wales, Sir Thomas Makdougall Brisbane (1773 – 1860), who was known for his interest in astronomy and mathematics. Rümker was his "personal astronomer" and was the first Government Astronomer in the country. In *CAI* (pages 32 – 33), I described him as Australia's first practising mathematician. "His most notable achievement … was the calculation

of the orbit of Encke's comet, which was first observed in Marseilles in 1818 and was only the second comet, Halley's being the first, whose return was accurately predicted," I wrote.

Morris Pell, at Sydney University, had only two assistants during his 24 years there. William Scott (1825 – 1917) had been a mathematics lecturer at Sidney Sussex College, Cambridge, before serving as astronomer in the Sydney observatory from 1856 to 1862. He was succeeded as Sydney astronomer by George Robarts Smalley (1822 – 1870), who had previously taught mathematics in King's College, Cambridge. Both were examiners for Pell in the 1860s.

Charles James Merfield (1866 – 1931) worked in both the Sydney and Melbourne observatories. Originally a surveying engineer, his mathematical expertise is demonstrated in the paper Merfield (1895). There were many other astronomers worthy of mention, such as Charles Todd (1826 – 1910) in Adelaide, noted also for his contributions to telecommunications and meteorology. Merfield and Todd were elected Fellows of the Royal Astronomical Society, as were James Cockle and New Zealand's W. S. Aldis, both included above.

Henry Skey (1836 – 1914) was a meteorologist and amateur astronomer associated with the Pope/Skey/Ferriman telescope in Ashburton College, at Ashburton in the Canterbury region. The paper Skey (1872) illustrates his familiarity with the design of telescopes.

Horace Lamb's lasting contribution to seismology has been noted above.

New Zealand's leading authority on seismology in the nineteenth century was George Hogben (1853 – 1920). He was born in London and, after studies in mathematics at Cambridge University, came to New Zealand in 1881 to teach at Christchurch Boys High School. That began an exceptional and innovative career as an educationalist, and, within ten years, a reputation also in seismology. His first papers gave his calculations for the epicentre and speed of propagation of earthquakes that had occurred in New Zealand in 1888 and 1890, based on recent mathematical methods devised by John Milne, a pioneer in seismology. Many other papers followed, analysing earthquakes throughout Australasia and the Pacific. See Hogben (1898) and Tee (2002).

Charles Edward Adams, above, was a surveyor among other qualifications. His father was Charles William Adams (1840 – 1918). The father was born in Tasmania and moved to Otago, New Zealand, in 1862. He was soon appointed an assistant surveyor, and rose to become, in 1885, chief surveyor in Otago. Two of his papers of interest in the New Zealand *Transactions* are Adams, C.W. (1878, 1881).

Martin Gardiner, above, was stated as being a surveyor by profession. He made a number of theoretical contributions to the area, such as the 66-page "On practical geodesy" (Gardiner 1878).

The Australasian Association for the Advancement of Science

The hundredth anniversary of the colonisation (or invasion) of Australia was seen as a fitting year for the Royal Society of New South Wales to host the inaugural meeting of the Australasian Association for the Advancement of Science (AAAS). With over 800 attending, the meeting took place in the University of Sydney from 27 August to 5 September, 1888, the culmination of discussions and pronouncements going back to the 1860s. Meetings were held every two or so years from then within ten sections, of which Section A was Astronomy, Mathematics, Physics, and Mechanics. William Bragg was President of Section A in 1892, and Alexander McAulay in 1895. (In 1930, there was a name change to the Australian and New Zealand Association for the Advancement of Science —ANZAAS.)

In the following, I list all mathematical contributions to the meetings of AAAS, up to and including the eighth meeting in 1900, as printed in the *Reports* of the meetings. Brief biographical comments are given regarding those authors not previously mentioned here. The list is separate from the *References* that conclude the paper.

Adams, C. W. (1892) "A graphic method of showing the relation between the temperature of the dew point and temperature of the air for any given climate" 4, 261 (no abstract or text).

Ball, R. (1895) "On a form of the differential equations of dynamics" 6, 215 – 217. Sir Robert Stawell Ball (1840 – 1913) was at that time the Lowndean Professor of Astronomy and Geometry at Cambridge. He also attended the 1892 meeting of AAAS.

Bragg, W. H. (1891) "The 'elastic medium' method of treating electrostatic theorems" 3, 57 – 71; (1895) "The energy of the electro-magnetic field" 6, 228 – 231.

Chapman, R. W. (1892) "On the dodging tide of South Australia" 4, 261 (no abstract or text); with Captain Inglis (1893) "The tides of Port Adelaide" 5, 272 – 279. (The latter are "results of the harmonic analysis of the tides".) Robert William Chapman (1866 – 1942) was appointed assistant lecturer in mathematics and physics in the University of Adelaide in 1889. In 1910, he succeeded Bragg as Elder Professor of Mathematics and Mechanics.

Farr, C. Coleridge (1898) “Four theorems in spherical harmonics” 7, 175 (no abstract or text).

Fleuri, G. (1893) “On Stokes’ theorem” 5, 297 – 301; (1893) “From number to quaternions” 5, 301 (no abstract or text); (1895) “An elementary exposition of the theory of power series” 6, 217 – 228.

Hogg, E. G. (1900) “On certain surface and volume integrals of an ellipsoid” 8, 191 – 195.

Knibbs, G. H. (1898) “A general expression for flow in tubes” 7, 267 (no abstract or text).

McAulay, A. (1890) “Note on the Eulerian equations of hydrodynamics” 2, 365 – 366; (1892) “Quaternions as an instrument of physical research” 4 (no abstract or text, or page number).

Michell, J. H. (1892) “On a property of algebraic curves” 4, 257 (abstract only); (1892) “On the bulging of flat plates” 4, 258 (abstract only).

Stuckey, J. J. (1893) “The application of mathematics to actuarial science” 5, 280 – 287. Little is known of Joseph James Stuckey beyond the material of the obituary in *The Adelaide Advertiser* (23 April 1917), page 6. He was an actuary, born in Adelaide in 1843. He showed great proficiency in mathematics, presumably as one of the first students of Horace Lamb, and went on to studies in Cambridge. He was an applicant for the position of “Assistant Mathematical Lecturer” at Adelaide in early 1888; the position went to Robert Chapman.

Sutherland, W. (1888) “On the law of molecular force” 1, 39 – 42; (1888) “Molecular refraction” 1, 42 – 45; (1890) “Further investigations on the laws of molecular force” 2, 368 – 371. A brother of Alexander Sutherland, above, William Sutherland (1859 – 1911) was born in Glasgow and was an applicant for the chair in Adelaide won by William Henry Bragg. See *CAI*, page 63.

Conclusion

Except for those in Otago and Wellington, all of the nineteenth-century professors of mathematics in Australasia have been named above, with an indication of their interests and publications. In the University of Otago, the first professor of mathematics and natural philosophy was John Shand (1834 – 1914), appointed in 1870. (Martin Gardiner was an applicant for this position.) In 1886, the chair was divided; Shand chose natural philosophy and the new appointee in mathematics was Frederick Gibbons—full name Frederick Bryan de Malbisse Gibbons, (*c*.1854 – 1924). In Wellington, Richard Cockburn Maclaurin (1870 – 1920) was appointed foundation professor of mathematics at the newly founded Victoria College in 1899. Maclaurin went on to become president of the Massachusetts

Institute of Technology. None of these three had relevant publications (that I could find) before 1900.

In all of these newly established universities, in both countries, the new professor was often alone in having responsibility for teaching and examining at all levels of the mathematics course, as well as encouraging school mathematics and taking on other duties to do with the university and the local community. Some laid more emphasis on the latter than on mathematical research. Only the two from Adelaide, Horace Lamb and William Henry Bragg, and two from Melbourne, Edward Nanson and John Henry Michell (and Ernest Rutherford at Christchurch, if we may borrow him as a mathematician) might figure in a modern world history of mathematical attainment.

The aim of this article was to see the foundations being laid for a rich, diverse and successful mathematical future in Australia and New Zealand.

Finally, a word about Garry John Tee, who died on 18 February 2024, aged 91. Garry was a pioneer of computer science (particularly, numerical analysis) in New Zealand, and a distinguished historian of mathematics in Australasia. His work on Charles Babbage's development of the difference engine and the analytic engine, forerunners of modern computers, is renowned, and Babbage's connections to Australia and New Zealand constitute some of Garry's best-known work. See, for example, Tee (1983). I feel honoured to have known him.

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