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Sir Thomas Brisbane – a man of scientific method

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Abstract

Sir Thomas Brisbane is a familiar name to those interested in the history of science in Australia. His astronomical observatory at Parramatta, established in 1821, marks the commencement of formal scientific work in the colony of New South Wales. This paper considers Brisbane's scientific achievements within the broader context of his work in Britain as well as Australia and his contributions to the development of professional science.

Introduction

Sir Thomas Brisbane was governor of New South Wales from 1821-1825. In those years he established a private astronomical observatory in the grounds of Government House at Parramatta. His colonial scientific achievements are part of a more extensive scientific career that deserves further consideration. At a time when the name 'scientist' was being invented, Brisbane's career displayed many of the characteristics of a modern scientist – a commitment to scientific investigation through observation, experimentation, publication and leadership including mentoring.

Born into the Scottish landed gentry, the Brisbane family home held an extensive library in English, French and Latin. Like others of their generation, their extended family participated in the intellectual pursuits of the Scottish enlightenment of the late 18th century. Thomas Brisbane (1773-1860) received a good general education at home

and in London before taking up his army commission when he was 17. He saw active service in Europe and the West Indies. While on half pay between 1805 and 1811, Brisbane developed his interest in astronomy into a life-time pursuit, both as a personal activity and as a public mentor for its expansion as a science.¹⁶

Observation

After a near disastrous Atlantic crossing with his regiment in 1795, when his vessel ended up off the coast of Africa instead of the West Indies, Brisbane resolved to learn basic astronomy used to navigate at sea.¹⁷

Back in Scotland, he was able to refine these skills in Greenock, the nearest town to his home in Ayrshire and Scotland's gateway to

¹⁶ Research for this paper was undertaken in the United Kingdom with the support of the C.H. Currey Fellowship, State Library of NSW.

¹⁷ Much of the detail of this paper is documented in Carol Liston, *New South Wales under Sir Thomas Brisbane 1821-1825*, PhD, University of Sydney, 1982.

the Atlantic. Schools and private academies taught astronomy and navigation in Scotland in the late 18th and early 19th century. Colin Lamont (1754-1851) was mathematics master at Greenock Grammar School from 1781. Skilled in astronomy and navigation, he had his own observatory at Greenock where he taught mathematics and navigation, as well as a navigation warehouse, selling and repairing navigational equipment (Gavine (1981)). It was natural that Brisbane turned to Lamont to refine his understandings of astronomy.

As heir to the family estate Brisbane had access to credit, which he used to develop his expensive hobby. In 1808 he had constructed in the grounds of Brisbane House a stone observatory, which he equipped with instruments, clocks and books, mostly purchased from leading suppliers in London.

In 1809 when the Glasgow Society for Promoting Astronomical Science was planning an observatory, they visited Colonel Brisbane the younger of Brisbane to see his observatory, and seek his advice. Brisbane assisted them in purchasing second hand instruments and he was invited to lay the foundation stone of their observatory in May 1810.¹⁸ In the same year, Brisbane was elected a member of the Royal Society of London and became a member of the Royal Society of Edinburgh in 1811.

When he returned to active service with the Duke of Wellington in the Peninsula in 1811, Brisbane's precision and time-keeping skills were an asset for the military. Time was the essential component of navigational astronomy. Brisbane observed the time by using a pocket sextant, a chronometer and artificial horizon (MNRSN (1861) p98).

¹⁸ Archives of Mitchells, Johnston & Co, T-MJ 98, Glasgow City Archives.

Wellington ordered that Brisbane's tables of the sun's altitudes be printed for the use of the army to assist with time-keeping. During the military occupation of France after Napoleon's defeat, Wellington ordered Brisbane to calculate comparative British and French weights to standardise the issue of military rations.

Brisbane was elected a Corresponding Member of the French Academy of Sciences in 1816 in recognition for saving their buildings from a 'rabble of German soldiers' (MNRSN (1861) p99). This honour provided an introduction to eminent French scientists who widened Brisbane's astronomical interests. He remained a lifelong personal friend of Alexis Bouvard (d.1843) whose computational skills led to the determination of the orbits of comets. Bouvard's calculations included the orbit of a comet in 1805 and 1818 that was subsequently called Encke's comet. Brisbane's observatory at Parramatta observed its return in June 1822 and his Makerstoun observatory in Scotland observed its return again in 1829.¹⁹

With the end of the Napoleonic Wars, Brisbane sought employment that would enable him to continue his astronomical interests. In 1821 he was appointed as the successor of Governor Macquarie in New South Wales. Brisbane immediately planned to establish a private observatory, removing equipment from his Brisbane Observatory, purchasing new equipment and hiring staff to assist him. Charles Rumker, a German navigational teacher previously employed by the Royal Navy, was appointed as a mathematician and calculator as well as

¹⁹ 1860/214; LBV1 f.341 *JD Forbes Papers*, University of St Andrews; <http://www-history.mcs.st-andrews.ac.uk/Biographies/Bouvard.html>; Royal Society of Edinburgh (D. Brewster ed) *The Edinburgh Journal of Science*, Vol 1, 1829, p182.

observer and James Dunlop, a Scot who made optical equipment, as technician and an assistant in the observatory.

The British government had decided to establish an official observatory at the Cape of Good Hope in 1820. Brisbane's private venture to another part of the southern hemisphere was seen as an important opportunity to extend knowledge of the southern skies. Longitude was Brisbane's first interest and on the voyage to Australia he observed stars, tested his various clocks and made magnetic observations. Rumker also observed on the voyage, and their unpublished notes were sent to the Royal Astronomical Society in London where they were read but not published.²⁰

Brisbane and his assistants started observing as soon as they arrived in late 1821 and the team occupied the new observatory at Parramatta from early 1822. Their main instruments were a transit of five and a half feet by Troughton, a mural circle of two feet by Troughton (brought from the Brisbane observatory) and a 16 inch repeating circle by Reichenbach, Utzschneider and Liebherr (Lomb (2004)).

Dr John Brinkley received regular correspondence from Brisbane, particularly about stars that were visible in both hemispheres. An astronomer and clergyman and the first Astronomer Royal of Ireland, Brinkley's astronomical investigations used Brisbane's Parramatta observations of south polar distances of fixed stars to assist his work on north polar distances.²¹ Brisbane arranged

²⁰ Royal Astronomical Society Archives, Parramatta files, various documents.

²¹ *Monthly Notices of the Royal Astronomical Society*, vol 1, 1828, p59; John Brinkley in *Complete Dictionary of Scientific Biography*, <http://www.encyclopedia.com/doc/1G2-2830900634.html>

for meteorological observations to be kept at various places around New South Wales, as well as at Parramatta. He sent these observations to correspondents throughout Europe. A meteorological table for 12 months from April 1823 to March 1824, sent by Brisbane to Dr Brinkley, was published in the *Dublin Philosophical Journal and Scientific Review* in 1825.²² Observations were carried out on the length of the pendulum. Published and commented on by Captain Henry Kater, the observations were used to calculate gravity, and subsequently used for standard measurements of the yard.

Brisbane had a wide circle of scientific acquaintances and sent back to these friends and their institutions many specimens of plants, minerals, small animals, reptiles and birds as well as the occasional ethnographic object and Aboriginal skeletal remains. He was awarded an Honorary LL.D in January 1823 from the University of Edinburgh in recognition of his large contributions to the University Museum of Natural History.

Experimentation

An Experimental Governor

Aware that they had appointed a scientist as well as a soldier, Lord Bathurst at the Colonial Office commented that he was pleased to hear of Brisbane's engagement with astronomy and asked for observations that he could pass on to associates.²³

The Parramatta Observatory by 1823 had conducted observations on Mars, a transit of Mercury, three solstices, two equinoxes, observations on two comets with their orbits after they had been lost sight of in Europe,

²² *Dublin Philosophical Journal and Scientific Review*, vol 1 1825 p150-1.

²³ Bathurst to Murray, 11 November 1822, *Bathurst Papers* British Museum Loan 57/64, p16.

eclipses of the sun, moon and Jupiter's satellites, and identification of stars in Lacaille's catalogue of southern stars made in the Cape of Good Hope in 1750-54.²⁴

Friction between Brisbane and Rumker in 1823 led to Rumker leaving the observatory to work at his farm near Picton. Brisbane continued observing after Rumker left, sending his work to the Royal Astronomical Society in London with a request for someone there to complete the mathematical calculations necessary to reduce the observations for publication, as he no longer had Rumker to do this work.²⁵

Brisbane's scientific status caused difficulties for the British government in encouraging further scientific inquiry in the colony whilst he was governor. In October 1823 Sir Robert Peel supported the request of the Board of Longitude and Sir Humphrey Davy that the British government encourage Brisbane to measure an arc of the meridian, having confidence in his scientific team (particularly Rumker) and their instruments.²⁶ Lord Bathurst agreed to instruct Brisbane to carry out this work, but warned it would need to be carefully worded, because 'the cry attempted to be raised against him in NSW is that he is an astronomer'.²⁷

A natural extension of the meteorological observations was to experiment with changing environments for the production of wool. Brisbane proposed that experiments on wool quality be conducted in the Hunter

Valley and Tasmania, latitudes equivalent to Spain and Saxony, which were known for their wool in Europe. He continued Caley's experimental garden at Parramatta and was successful with Virginia tobacco and Georgian cotton seed.²⁸

Probably his most daring application of scientific method in New South Wales was its application to a social environment – the management of the colony. Brisbane changed many aspects of colonial administration in his first three months in office, having digested the criticisms of Governor Macquarie and the evidence provided to Commissioner Bigge. These changes ranged from convict administration to the distribution of land. Brisbane then observed the impact of these changes but did not tinker with the arrangements he had set in place. He refused to send partial results to the Colonial Office, wanting to wait until the outcomes were clear. It was foolhardy to leave them in the dark about his administration, as it provided the opportunity for his critics to send reports to the British government that had no information to defend Brisbane.²⁹

Makerstoun

Recalled from the government of New South Wales at the end of 1825, Brisbane returned to Scotland and established his family at Makerstoun, his wife's family home near Kelso, where he had built his third astronomical observatory by 1828. In 1838 12 chronometers were taken from Greenwich to Brisbane's observatory at Makerstoun to confirm the latitude of both locations.³⁰

²⁴ Brisbane to ? (Cork Institution?) 24 February 1823, D207/67/58 Public Record Office of Northern Ireland.

²⁵ Brisbane to F. Bailey RAS, 2 July 1825, *Royal Astronomical Society Archives*, Parramatta files 19.1.

²⁶ Peel to Bathurst, 20 October 1823 *Peel Papers*, British Library MS 40358, f.302 (check HRA).

²⁷ Bathurst to Peel, 21 October 1823, *Peel Papers* British Library MS 40358, f.309.

²⁸ Brisbane to ? (Cork Institution?) 24 February 1823, D207/67/58 Public Record Office of Northern Ireland.

²⁹ Brisbane to Craufurd, 1 May 1823, *Brisbane Papers* PRO PMG1/1.

³⁰ Gavine, p162.

Brisbane built a magnetic observatory at Makerstoun near his astronomical observatory and employed a team of scientists throughout the 1840s. Russell was followed by John Brown, a student of Professor James David Forbes, who arranged with the Astronomer Royal George Airy, on Brisbane's behalf, for Brown to spend a few weeks working with James Glaisher at the Greenwich Magnetic Observatory.³¹ Brown, Welsh and Hogg worked at Makerstoun until 1849, when they moved to Edinburgh to focus on the calculations of their observations.

Publication

Brisbane was committed to publication and the distribution of the results of his observations and experiments. In many instances, particularly with meteorological observations the results were sent with correspondence to friends and acquaintances throughout Europe and published without commentary apart from the names of the observers— Brisbane, Rumker, Dunlop – and details of the instruments used. In the pre-computer age, the mathematical calculations needed to put the astronomical results in a format useful for comparative analysis meant many years of work, and the expense of publication of lengthy tables. Brisbane frequently contributed toward the cost of publication.

As Brisbane personally funded the work of his observatories, he expected acknowledgement of his investment as well as of his own work within the observatories. In January 1830 Brisbane wrote to the Royal Society in London asking how they had obtained the observations made at his observatory at Parramatta in 1821-23 that

were recently published in the Society's *Philosophical Transactions*.³²

Edward Sabine, Secretary of the Royal Society, explained in February 1830. When Rumker was appointed government astronomer in New South Wales, he was instructed by the Colonial Office to report all his observations to the government and not to publish in learned societies by sending information directly to them. When his reports began to arrive, the British government consulted the council of the Royal Society that recommended, as the government printed the Greenwich observations, it should also print the Parramatta observations. Rumker's reports were printed at the expense of the Colonial Office under Rumker's superintendence. The government then placed all the copies with the Royal Society, which distributed them as an extra part of its *Philosophical Transactions*. The Royal Society did not regard the inclusion of earlier materials observed while Rumker was employed by Brisbane as a problem, as the government observations were a continuation of the same work, so therefore to the public's advantage to know about them.³³

Brisbane had given his own records of the Parramatta Observatory – the bound books of the transit and mural circle – to the Royal Society in February 1829 and their publication had been recommended to the government. These observations were still being mathematically reduced by William Richardson at Greenwich Observatory and would not be published for at least another year (and indeed were not published until 1835).

³² Report on Parramatta observations, *Royal Astronomical Society Archives*, Bailey files MSS 5.24.

³³ Sabine to Brisbane, 6 Feb 1830 *Royal Astronomical Society Archives*, Bailey files MSS 5.26.

³¹ LBIII, f.340, 578 JD Forbes Papers, University of St Andrews.

The Royal Society had published the work of the employee without acknowledgement of the employer – and in advance of his own work being published. Brisbane's investment in the observatory, the instruments and the salaries of the observers had been completely ignored. The observations from the end of 1821 until June 1823 should have recognised Brisbane. It was only after Brisbane left the colony at the end of 1825, having sold the observatory equipment to the colonial government, which then appointed Rumker as government astronomer, that the government observations could properly be seen as Rumker's work.

Further investigation into the records of the Parramatta Observatory revealed that whilst Brisbane believed he had the official records in his observatory workbooks, Rumker had in fact used loose bits of paper for his observations. Furthermore, when Rumker retired, he took the books to reduce the observations and refused to hand them over to Brisbane when he was leaving the colony. Brisbane was unable to get the books back before he sailed from Australia, but sent his clerk to copy them at Rumker's farm.

Representations from the Royal Society to the Colonial Office in May 1828 led to the Governor of New South Wales directing Rumker to hand over the volumes. As Rumker was going to Britain he was allowed to bring them with him and handed them over in June 1829. However, what he handed over were reams of paper in Rumker's handwriting not the bound books, so Richardson who was charged with reducing Brisbane's observations was concerned that they were not the original observations. Rumker acknowledged that they were only copies, with the originals being given to the Royal Society. He always used loose paper,

and only used the books for calculations, and jottings and had torn out pages when he needed to make a better set of records for himself or to use for spare paper!³⁴

The incident raised important principles at a time when the processes for funding science and the rigour of scientific methods of recording were just emerging. The concern of a committee of the Royal Astronomical Society was that every observatory should keep the original observations. Rumker gave the Colonial Office copies of a second set. Unknown to Brisbane, Rumker had been keeping a second set of records for his own use, more perfect than the observations recorded in the bound volumes that were Brisbane's property and which Brisbane believed contained the true record of the whole of his observatory's work.³⁵

Despite the controversy over Rumker's publications, Rumker maintained correspondence with Brisbane, sending him in 1844 his most recent catalogue of fixed stars, which included Brisbane's own observations, and his manual of navigation.³⁶

Brisbane's records of the Parramatta Observatory were finally reduced by William Richardson and published as *A Catalogue of 7385 Stars chiefly in the Southern Hemisphere* (the Parramatta catalogue) in 1835. In the mid 1840s Greenwich Observatory returned Richardson's manuscripts for the Brisbane catalogue to Brisbane for deposit at the Royal Astronomical Society when it cleaned out

³⁴ Rumker's statement on Parramatta observations, *Royal Astronomical Society Archives*, Bailey files MSS 5.7.

³⁵ Report on Parramatta observations 5 June 1830, *Royal Astronomical Society Archives*, Bailey files MSS 5.5.

³⁶ 1844/58, JD Forbes Papers, University of St Andrews.

Richardson's office after he was dismissed from the observatory.³⁷

After Brisbane's death, Rumker sent his original Parramatta observations to the Royal Astronomical Society, commenting that declining health preventing him from working on them to reduce them. These included original observations for 1822-3; Rumker's copies of observations in these years; Brisbane's own transit observations for 1823-24; Brisbane and Dunlop's original observations for 1824-25; Dunlop's observations for 1824-25 and various observations by Dunlop and Rumker in 1826-27. The full record of the work of Brisbane's Parramatta Observatory was never available in print, nor ever consolidated as manuscript in one place, during the lifetimes of either Brisbane or Rumker.

In 1842 the Royal Society of Edinburgh agreed to publish the magnetic observations from Brisbane's Makerstoun Observatory.³⁸ The first part of the observations appeared in the *Transactions* in 1845 but further publication was delayed due to the mass of data and complications in reducing it for publication. Adding machines were used but double-checking of calculations made it a massive task.³⁹ The final publication covered 1,800 pages, being the most north-western observations of their kind in Europe and made entirely at a privately funded observatory. Brisbane was awarded the Keith Medal for this work in 1848, with his

astronomer John Allan Brown recognised with the award of a silver Keith Medal.⁴⁰ Brown's subsequent publications on magnetic observations established the link between sunspots and magnetic storms (Campbell and Smellie (1983) p42). Further observations from Makerstoun were considered for publication in 1857 and a supplement of observations by Balfour Stewart, director of Kew Observatory, was published in 1861.

Leadership and Mentoring

Learned Societies

The early 19th century saw a profusion of societies to encourage scientific work. Learned societies were about social networks and communication and were initially formed by gentlemen interested in natural science. By the mid 19th century, as technical expertise became more professional with university education, the new scientists took a stronger role.

The Royal Astronomical Society was established in London in 1820 and Brisbane was among its early members, presenting books to it in March 1820 (Dreyer and Turner (1923)). A decade later Brisbane was among those assembled at York in 1831 for the first meeting of the British Association for the Advancement of Science and he attended most of its meetings in the 1830s (Howarth (1931)).

When Brisbane returned from New South Wales, he served as a councillor and vice-president of the Royal Society of Edinburgh and succeeded Sir Walter Scott as President in November 1832. He was proposed by Dr Thomas Charles Hope, professor of medicine and chemistry at the University of Edinburgh (Hope had also nominated him for

³⁷ In 1845 William Richardson was dismissed from Greenwich observatory when he was charged, though subsequently acquitted, of concealing the birth and death of the baby he had fathered to his daughter. *Proceedings of the Old Bailey*, 11 May 1846 <http://www.oldbaileyonline.org>.

³⁸ *Minutes of the Council of the Royal Society of Edinburgh*, 28 April 1842.

³⁹ *Minutes of the Council of the Royal Society of Edinburgh* 22 November 1848.

⁴⁰ *Minutes of the Council of the Royal Society of Edinburgh*, 18 February 1848.

membership in 1811) and seconded by Sir David Brewster, physicist.⁴¹ This was a position traditionally held for life and, despite offering to resign due to declining health in 1851, Brisbane held the presidency until his death in 1860, the last president to do so.

Brisbane was also President of the Edinburgh Astronomical Institution from 1834, when Thomas Henderson became Astronomer Royal for Scotland, until 1846 when it was wound up. Brisbane provided the reflecting circle that Henderson used (Gavine (1981) p153). The Astronomical Institute managed the Royal Observatory on Calton Hill, Edinburgh. In 1846 Brisbane called a meeting to consider whether the observatory should be handed over to the government in exchange for repairs and funding for the position of the Astronomer Royal for Scotland and the Professor of Practical Astronomy at Edinburgh University.⁴² Brisbane provided funding for Edinburgh Observatory to purchase a Dent transit clock in 1858, and Lady Brisbane offered it equipment on his death (Gavine (1981) pp178, 180). The catalogue of Brisbane's astronomical instruments that he owned at the time of his death filled six pages, including telescopes, clocks, thermometers, barometers and compasses. His clocks, in particular, were considered very good.⁴³

Patronage and developing scientists

Brisbane's support for the career of James Dunlop is a well-known colonial example of his mentoring. Dunlop (born Dalry, Scotland 1793) was a natural, self-taught technician

whom Brisbane took to New South Wales as his assistant. He trained Dunlop as an observer and Dunlop later returned to Scotland and worked with Brisbane at Makerstoun for four years. Brisbane proposed James Dunlop as a member of the Royal Society of Edinburgh, describing him as an eminent observer, whose scientific contributions would add to their published transactions. Brisbane noted that it would be difficult for Dunlop to pay membership fees and proposed him for free membership under the rules for deserving parties and this was accepted in 1831.⁴⁴ Dunlop returned to the colony in 1831 in charge of the Parramatta Observatory, a position he held until retiring in ill-health in 1847.⁴⁵

Brisbane was a mentor of James David Forbes, a self-taught scientist, who became Professor of Natural Philosophy at the University of Edinburgh in 1833 at the age of 23. Forbes held the position until 1860, the year of Brisbane's death, when he succeeded Sir David Brewster as Principal of St Andrews University. Forbes was General Secretary of the Royal Society of Edinburgh for 20 years (Campbell and Smellie (1983) p45).

Forbes had approached Brisbane in 1830 for advice on purchasing astronomical equipment for the Royal Society of Edinburgh and requested his patronage for membership of the Geographical Society.⁴⁶ Brisbane supported the career of Forbes, admiring his 'superior qualifications on all subjects of science and analytical investigation but also many original discoveries, particularly the

⁴¹ *Minutes of the Council of the Royal Society of Edinburgh*, 26 November 1832.

⁴² 1846/29 *JD Forbes Papers*, University of St Andrews.

⁴³ *Catalogue of the valuable astronomical and philosophical instruments of the late General Sir Thomas Makdougall Brisbane, Edinburgh* 1860, Royal Greenwich Observatory, Sussex.

⁴⁴ *Minutes of the Council of the Royal Society of Edinburgh*, 5 December 1831.

⁴⁵ H. Wood, James Dunlop (1793-1848) *Australian Dictionary of Biography*.

⁴⁶ LB 1 f.354, *JD Forbes Papers*, University of St Andrews.

polarization of heat'.⁴⁷ John Herschel supported Forbes at Brisbane's request, commenting that men capable of brilliant original research should be relieved from seeking an income while their brain was active so that they could pursue their researches.⁴⁸

Forbes became a regular house-guest at Makerstoun where he used the observatory for his work. Forbes advised Brisbane on setting up the magnetic observatory at Makerstoun and put him in touch with Professor Humphrey Lloyd, Professor of Natural Philosophy at the University of Dublin who had been responsible for establishing magnetic observatories in Ireland in the 1830s.⁴⁹ Forbes was extensively involved in the superintendence of the project.⁵⁰ Following Brisbane's death it was Forbes who assisted the family in the sale and distribution of the astronomical equipment, again consulting Lloyd in Dublin about the fate of the magnetic observatory equipment.⁵¹

Brisbane's observatory at Makerstoun became a training ground for a generation of British astronomers. John Allan Brown was a pupil of Forbes, and Brisbane appointed him as astronomer for his magnetic observatory at Makerstoun. Both Forbes and Brisbane supported Brown's unsuccessful application for the chair of Practical astronomy in Edinburgh in 1844. Brown was subsequently

Astronomer to the Travancore Sircar, India and Director of its Observatory from 1852-1865. John Welsh was 18 when he started work at Makerstoun under Brown's leadership from 1843 till 1849, then working for Brisbane in Edinburgh until 1850. Welsh was subsequently appointed Superintendent of the Kew observatory in London from 1852 to 1859.⁵²

In conferring the medal of the Royal Astronomical Society on Sir Thomas Brisbane in 1828, it was noted that the first fruits of colonization were in so many lands rape and violence towards its 'unoffending inhabitants' but that in Australia through the work of Brisbane, the first triumph of colonisation was the peaceful one of science and useful knowledge for the future (MNRSN (1828)).

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- ⁴⁷ Brisbane to Furley, 24 December 1841, *Peel Papers*, British Library MS 40498, f.157.
- ⁴⁸ Herschel to Brisbane, 2 Jan 1842, *Peel Papers* British Library MS 40509, f. 164-5.
- ⁴⁹ F.E. Dixon, 'More Irish Meteorologists', *Irish Astronomical Journal*, vol 9, 1970, pp 240-2 (accessed http://articles.adsabs.harvard.edu/cgi-bin/nph-article_query?bibcode=1970IrAJ....9..240D&db_key=AST&page_ind=0&plate_select=NO&data_type=GI&type=SCREEN_GIF&classic=YES).
- ⁵⁰ *Minutes of the Council of the Royal Society of Edinburgh*, 18 November 1850.
- ⁵¹ LBVI, f.192, JD Forbes Papers, University of St Andrews.
- ⁵² 1861/113; 1861/119, *JD Forbes Papers*, University of St Andrews.

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