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# The History of the Rossbank Observatory, Tasmania

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**Summary**

Rossbank functioned from 1840 to 1854 as one of a chain of British Colonial Observatories which combined with European and Asian observatories in the study of terrestrial magnetism. It was established in Hobart, Tasmania, by the Governor of Van Diemen's Land, Sir John Franklin, and Captain James Clark Ross, R.N., commanding H.M. ships *Erebus* and *Terror*. The history and operation of the Rossbank Observatory is related, its instruments described, and the results discussed.

Biographical notes on the Observatory staff, with lists of its archives and instruments are provided. A number of previously unpublished pictures show the Observatory in use and the surviving buildings and instruments today.

**Contents**



## 1. Introduction

At any place upon the Earth a freely-suspended magnet will take up a position with respect to three axes: geographic north, geographic east, and a line vertically downwards. The horizontal angle between a magnetic needle and geographic north is termed the *declination* or *variation*. The vertical angle between the needle and the local horizontal plane is termed *inclination* or *dip*. The *force* or *intensity* of the Earth's magnetic field varies spatially and temporally and may be measured either in terms of its vertical and horizontal components or as *total force*. During the eighteenth and early nineteenth centuries, much time and effort was expended on questions concerning the Earth's magnetic field. Voyages into Hudson Bay, towards the Northwest Passage, and in the Greenland Seas in search of whales, were all taken at great risk, for in Arctic regions the sky is frequently obscured, the compass behaves erratically, and navigation through ice-bound waters is perilous. It was in the best interests of the Royal Navy and of private ship-owners that geomagnetic instruments should be carried on such voyages and used whenever circumstances permitted, the information gained being of value to all navigators.

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By the 1840s, assiduous travellers overland had measured the magnetic elements across much of the inhabited world, and fixed observatories were being founded. However, values were ill-defined across the oceans, as few ships sailed with the principal aim of collecting magnetic data, nor were measurements easily made on board a vessel under way. Nevertheless, it was becoming apparent that the great expanse of the southern oceans had different magnetic characteristics from those of the Arctic regions.

The Prussian scientist and traveller, Alexander von Humboldt, had encouraged the founding of many European magnetic observatories, of which twenty-three were operating by 1834. His contemporary and compatriot, the great physicist Carl Friedrich Gauss, organized the *Magnetische Verein* (a union of Eurasian magnetic observatories), which, using standard instruments devised by Gauss and his assistant Wilhelm Weber, assembled and compared their results.[1] When the French physicist François Arago addressed the British Association for the Advancement of Science in 1838, he could assure its Committee that France was building observatories in her overseas territories, and he hoped that Britain would do likewise. The British Association decided to follow suit. Lord Melbourne, the first Prime Minister of Queen Victoria's long reign, accepted their resolutions together with a subsequent report of the Joint Committee of Physics and Meteorology of the Royal Society.[2]

British India, not yet the brightest jewel in the Imperial Crown, was still largely ruled by the Honourable East India Company. With the support of the Company and the British Government, a chain of 'Colonial Magnetic Observatories' was to be established, situated to take advantage of certain magnetic features. The East India Company Observatories were: Simla, under Lieut. Boileau of the Bengal Engineers; Madras, under Lieut. Ludlow of the Madras Engineers, and Singapore under Lieut. Elliott of the same regiment. The British Government was responsible for Toronto, St. Helena, and the Cape of Good Hope Observatories, all staffed by Royal Artillery detachments, and for Hobart, which was administered by the Navy. The Royal Society recommended to the British Government that an Antarctic voyage should be made while the observatories were being set up. This would supply further observations of the greatest importance and value and, it was hoped, establish the whereabouts of the South Magnetic Pole.

Toronto and Hobart lay near the points of maximum intensity in their respective hemispheres. St. Helena, Madras, and Singapore all lay near the Magnetic Equator. The Cape of Good Hope (which already had an astronomical observatory) was located in the poorly-known southern hemisphere. Simla, in the Himalayas, was chosen for its height above sea level (to discover how the magnetic field differed above the Earth). The observatories were regularly to measure magnetic declination, dip, and intensity, for three years, and on certain 'Term Days' at very frequent intervals, in concert with one another and with the European observatories.

This paper is concerned with the magnetic observatory known as Rossbank, set up at Hobart Town, Van Diemen's Land, which continued in operation for fourteen years from 1840 to 1854.

[1] For a history of international collaboration in magnetic observations within the Old World prior to 1839, see J. Cawood, 'Terrestrial Magnetism and the Development of International Collaboration in the Early Ninteenth Century', *Annals of Science*, 34 (1977), 551–87.

[2] *Report of the Committee of Physics and Meteorology of the Royal Society Relative to the Observations to be Made on the Antarctic Expedition and in the Magnetic Observatories* (London, 1840), p. 11.

## 2. Establishment and operation, 1840–54

Captain (later Admiral Sir) James Clark Ross (1800–62),[3] F.R.S. (Figure 1), who set up the Rossbank Magnetic Observatory and after whom it was named, was the most experienced of all the scientific 'Arctic Officers' of the Navy in the first half of the nineteenth century. He first went north under his uncle Captain (later Admiral Sir)

Figure 1.

Sir James Clark Ross, R. N., (1800–62) by John Wildman (*fl.* 1823–39). Oil in National Maritime Museum, Greenwich (No. 65–11; Neg. A.7326). Purchased with the Caird Fund, 1965. 57 in. (145 cm) × 44 in. (112 cm). The portrait was painted 1833–34. In the top right-hand corner of the canvas is the pole star. A dip circle stands on the table, lower right.

Courtesy of the Trustees of the National Maritime Museum.

[3] There is no biography of Ross, but see *Proceedings of the Royal Society*, 12 (1863), lxi–lxiii; *Dictionary of National Biography* (1897); Ernest S. Dodge, *The Polar Rosses* (London, 1973), and Ann Savours, 'Sir James Clark Ross', *Geographical Journal*, 128 (1962), 325–7; and M. J. Ross, *Ross in the Antarctic* (Whitby, 1982).

John Ross (1777–1856) on the earliest of a series of exploring voyages, despatched by the Admiralty after the Napoleonic Wars, in search of the Northwest Passage or towards the North Pole. He then served under Captain (later Admiral Sir) William Edward Parry (1790–1855) on his four Arctic Expeditions between 1819 and 1827. He was second in command to Captain Ross on the privately-financed exploring voyage of 1829–33, during which he located the North Magnetic Pole, then situated off the west coast of Boothia Peninsula in northern Canada, arriving 'at this great object of our ambition' on 1 June 1831. In the summer of 1835, and from August 1837 to the close of 1838, the younger Ross collaborated with Sabine, Fox, Lloyd, and Phillips in making a magnetic survey of Great Britain and Ireland. After this very considerable scientific and exploring experience (which included a relief voyage to Davis Strait in 1836), he was the obvious choice as commander of the Antarctic expedition of 1839–43 in H.M. ships *Erebus* and *Terror*, formed to further 'that great branch of science called Terrestrial Magnetism'.

Ross received his commission for H.M.S. *Erebus* on 8 April 1839, as did his second-in-command, Commander F. R. M. Crozier, for the *Terror* a month later. Ross described the formation, equipment, and proceedings of the expedition in his *Voyage of discovery and research in the Southern and Antarctic regions* (London, 1847). Its scientific and geographical accomplishments were many. During the circumnavigation, observatories were established at St. Helena, Cape Town, and Hobart. Ross was the first to navigate the pack ice of the Ross Sea, reaching McMurdo Sound. He discovered Victoria Land, and was the first to sail along the 'Icy Barrier', now known as the Ross Ice Shelf. He also discovered the James Ross Island group. It proved impossible for the ships to attain the South Magnetic Pole, since it lay behind the mountains of Victoria Land. Ross wrote as follows of his disappointment:

> Had it been possible to have found a place of security upon any part of this coast where we might have wintered, in sight of the brilliant burning mountain [Mount Erebus] and at so short a distance from the magnetic pole, both of those interesting spots might easily have been reached by travelling parties in the following spring; but all our efforts to effect that object proved quite unsuccessful; and although our hopes of complete attainment were not realised, yet it was some satisfaction to know that we had approached the pole some hundreds of miles nearer than any of our predecessors; and from the multitude of observations that were made in so many different directions from it, its position may be determined with nearly as much accuracy as if we had actually reached the spot itself.[4]

Ross was thus denied a double magnetic triumph. The mean position of the South Magnetic Pole was only reached by sledge some sixty years later in 1909, during Shackleton's *Nimrod* expedition. 'It was an intense satisfaction and relief to all of us' wrote Professor T. W. Edgeworth David afterwards, 'to feel that at last after so many days of toil, hardship and danger, we had been able ... to fulfil the wish of Sir James Clarke [*sic*] Ross that the South Magnetic Pole should actually be reached, as he had already in 1831 reached the North Magnetic Pole'.[5]

[4] James Clark Ross, *A Voyage of Discovery and Research in the Southern and Antarctic Regions*, 2 vols (London, 1847), I, 246–7.

[5] E. H. Shackleton, *The Heart of the Antarctic*, 2 vols (London, 1909), II, 181.

The Lieutenant-Governor of Van Diemen's Land in 1840 was Captain Sir John Franklin (1786–1847)[6] R.N., F.R.S., famous for his two overland expeditions across Canada to the Arctic Ocean in the years 1819–22 and 1825–27. He received official notice on 12 January 1840 of the proposed observatory and of Ross's impending arrival in a letter from the Secretary of State for the Colonies dated Downing Street, 12 September 1839:[7]

> Sir,
>
> I transmit to you a copy of a letter from the Secretary to the Admiralty, with a copy of one conveying the sanction of the Lords of the Treasury for the expense of an observatory for Magnetic Observations, to be erected in Van Diemen's Land in connexion with a scientific voyage under Captain Ross, R.N., and I have to request that you will take measures for having the Frame Work etc. prepared for erection on Captain Ross' arrival.
>
> I have the honor to be Sir
>
> Your most obedient servant
>
> Russell.

The enclosures showed that sanction had been given by the Treasury for the erection of the building at a cost of no more than £208, to be issued by the officer-in-charge of the Commissariat in Van Diemen's Land from the Military Chest.

The *Erebus* and *Terror*, having departed from England in October 1839, reached Tasmania and anchored in the Derwent in August 1840. Ross

> immediately proceeded to Government-house and received the most kind welcome from our warm-hearted friends Sir John and Lady Franklin. Anxious to get the permanent observatory at work as speedily as possible, I was rejoiced to learn from the Lieutenant Governor that the materials of which it was to be constructed had been prepared several months, according to a plan sent from England, and ready to be put together as soon as the site should be determined upon; I therefore accompanied Sir John Franklin the next morning to examine several places which he thought likely; and having selected that which appeared to me the most unexceptionable for the purpose, a party of two hundred convicts were the same afternoon set to work to dig the foundation, prepare the blocks of freestone which were to form its base, and the solid pillars of the same materials, which were to be the supports for the instruments, and bring the prepared timbers from the government store. The spot selected for the building is in the government demesne, near the site of the proposed new Government-house and commands a delightful view of the beautiful river Derwent and surrounding country. Its chief advantage, however, as a magnetic station, arises from its being placed over a thick bed of sandstone, which having been quarried to the depth of thirty or forty feet prevents all doubt as to the geological character of the substratum, a circumstance of first importance in all magnetic operations, and more especially so in a country where are to be found such manifest indications of its igneous origin... Under the daily superintendence of Sir John Franklin, the

[6] See the various biographies of Franklin of which the most recent is Rodney Owen, *Fate of Franklin* (London, 1978). For his lieutenant-governorship, see K. Fitzpatrick, *Sir John Franklin in Tasmania* (Melbourne, 1949), and Frank Debenham, 'The Erebus and Terror at Hobart', *Polar Record*, 3 (1942), 468–75.

[7] Archives Office of Tasmania, Governor's Inwards Despatches, G.O. 1.35.

> zealous co-operation of Major Kelsall of the Royal Engineers, and the able and indefatigable exertions of Mr. Howe, the Clerk of Works, the building of the Observatory proceeded most rapidly, and the whole was completed and roofed in, the stone pillars fixed upon the solid sandstone rock, the instruments placed on them, and all their delicate adjustments fulfilled, a few hours before the term-day observations of the 27th of August were to be commenced.

The erection of the Observatory was thus accomplished in nine days, 'an instance' wrote Ross, 'of what may be done where the hearts and energies of all are united to promote the common object of their endeavours'. He expressed his admiration for 'the cheerful enthusiasm which the convicts employed in the building displayed throughout the work', and as an instance of this, mentioned that after they had been labouring from six o'clock on Saturday morning until ten at night, seeing that a few more hours of work would complete the roofing-in, 'they entreated permission to finish it before they left off; but as it would have broken in upon the Sabbath morning, their request was very properly refused: this is only one of several such instances of their disinterested zeal in the cause, for, from their situation, they could not derive any benefit from their additional labour, and must have, on the occasion above mentioned, suffered much fatigue from their unusually prolonged exertions'.[8] Ross's favourable opinion of the area has, however, not been borne out by later scientists. Professors A. McAuley and E. C. Hogg in their preliminary magnetic survey of Tasmania, in 1901, did not select Rossbank, despite the obvious value of comparison with Kay's records. This was because magnetic greenstone outcrops in the Domain, and it seems likely that greenstone dykes penetrate the sandstones near to Kay's site. Mr. M. R. Banks of the Geology Department, University of Tasmania, tells us that the site would certainly not be chosen today.[9]

The ships' portable observatories were put up at convenient distances from the permanent observatory, and with the aid of volunteer assistants, 'there were obtained a very complete and satisfactory series of observations throughout the 27th and 28th August with two sets of magnetometers, in which the three instruments of each simultaneously recorded at every interval of two and a half minutes throughout the twenty-four hours'. Ross comments on the great advantage of obtaining the readings of *all three* instruments at each interval and remarks that 'the system was subsequently adopted at my earnest recommendations at the observatories of St. Helena, Cape of Good Hope and Toronto, and by all those established by the liberality of the Russian government throughout its extensive dominions'.[10] He goes on to describe the permanent observatory or instrument room, which was insulated from the variations of external temperature during the temporary removal of the instruments at the end of the Term-Day observations, by the addition of a second or exterior roof prolonged into a verandah. 'The building', he wrote, 'which is forty-eight [feet] long by sixteen broad, is entirely of wood, and care was taken that not the smallest particle of metal of any kind was used in its construction, the whole of the fastenings being of wooden pegs'. The instruments were placed on pillars of sandstone, 'fixed in the solid rock, of the same foundation, and defended from any influence the heat of the body of the observer might have upon them by the intervention of a closely fitted deal partition; the observer

[8] Ross (footnote 4), I, 108–11.

[9] E. G. Hogg, 'The magnetic survey of Tasmania', *Papers and Proceedings of the Royal Society of Tasmania* (1900–1901), 81–88, and M. R. Banks, personal communication.

[10] Ross (footnote 4), I, 111–2.

reading off the instrument by means of a telescope also fixed on a smaller pillar of the same kind, through a small aperture in the wooden partition several feet distant from the instrument'. Ross describes how 'In the astronomical observatory the transit instrument was properly adjusted, the clocks fixed in their places, and observations, with the invariable pendulums for determining the figure of the earth commenced by myself; Commander Crozier having under his more immediate superintendence the magnetometric observations, which were now continued uninterruptedly every hour throughout the day and night, and afforded full occupation to all the officers of the Expedition who had not other duties to perform'.[11] Ross, indeed, was said to be devoted to his beloved pendulum. His hammock swung close to it, and he could see it at any moment through a hole in the thin partition. Crozier's hammock was also close alongside.[12]

In the Tasmanian Museum (Hobart) is an oil painting by the Tasmanian artist Thomas Bock showing Franklin, Ross, and Crozier outside the Observatory, overlooked by Mount Direction on the north bank of the Derwent (Figure 2). Lieutenant Kay, R.N., later the Director, appears in the background. Mrs. K. Fitzpatrick, in *Sir John Franklin in Tasmania* (Melbourne, 1949), remarks that Ross is depicted with a sprig of silver wattle in his buttonhole 'to make a good Tasmanian of him'. The watercolour sketch for the painting is in the Tasmanian Museum. A pleasant vignette entitled 'Rossbank Observatory—Hobart Town', by John Edward Davis, Second Master of H.M.S. *Terror* forms the headpiece to chapter five of the first volume of Ross's narrative (Figure 3). A small watercolour of the Observatory by F. G. Simpkinson (later de Wesselow) is in the Crowther Collection of the State Library of Tasmania (Figure 4). A further three views, painted in the vicinity by Simpkinson, are in the Tasmanian Museum.[13] These illustrations bear out the truth of Ross's remarks that the several buildings all included within the boundary palings of the Government grounds formed a pretty-looking little village. It was here that, 'without interruption or annoyance, the gratifying and unceasing round of observations proceeded most comfortably and satisfactorily'.[14] Debenham (1942)[15] quotes from Lady Franklin's diaries on the subject of a possible name for the Observatory: 'When "Gauss Villa" was proposed', she wrote, 'I did not like the skittish title of villa and I also thought it might as well bear the name of Ross as of Gauss, but I could not give utterance to this sentiment in the presence of the hero himself'. The site was, in fact, designated Rossbank by her husband, the Lieutenant-Governor.

The local newspapers made much of the two visits of the *Erebus* and *Terror*. The *Hobart Town Courier* described the objects and equipment of the expedition in its leader of 21 August 1840. It exhorted its readers to 'show that Van Diemen's Land, which is the maximum point of intensity in magnetism is not the minimum one in all that appertains to the social relations of life'. Towards the end of their first stay, the

[11] Ross (footnote 4), i, 113.

[12] *Life and letters of Sir Joseph Dalton Hooker*, edited by L. Huxley, 2 vols (London, 1918), i, 105, footnote 2.

[13] For a contemporary view of 'The Beautiful River Derwent' see the lithograph by C. Hutchins after Captain C. S. Hext from Hext's *Views in Australia and Tasmania* (Liverpool, 1845). Copy in the Mitchell Library, Sydney. The print is reproduced and dated 1842, in Clifford Craig's *Old Tasmanian Prints* (Launceston, Tasmania, 1964).

[14] Ross (footnote 4), i, 113.

[15] Debenham (footnote 6).

*Hobart Town Advertiser* of 16 October 1840 reported that

> Her Majesty's ships *Erebus* and *Terror* will take their departure at the end of the present month, leaving behind them several officers to carry on the details of the Observatory. We understand the portable cabins and observatories have been visited by numbers of the inhabitants, who have always been most courteously received. The magnetic instruments are some of the most expensive and costly ever made, the expense of which it is said amounted to £57,000 . . . An anecdote is told of one of the fashionable *belles*, who was gratified with a view of the different "—meters" in the Observatory, and on leaning over to obtain "a sight", set the instrument vibrating, which afterwards took the officer in charge three days to make good the reckoning. It is said the fair lady had on a steel bust, which did so much unintentional mischief.

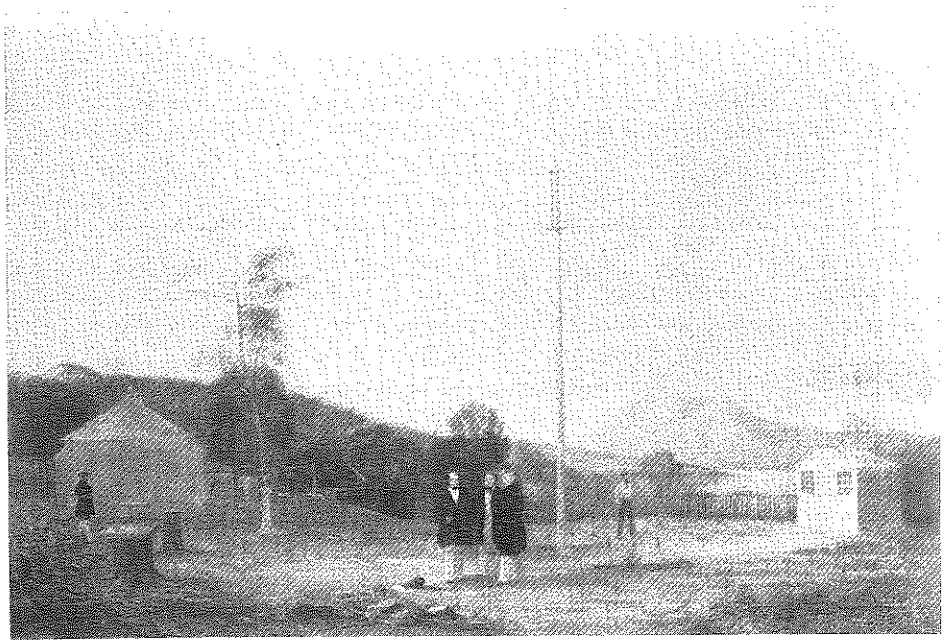
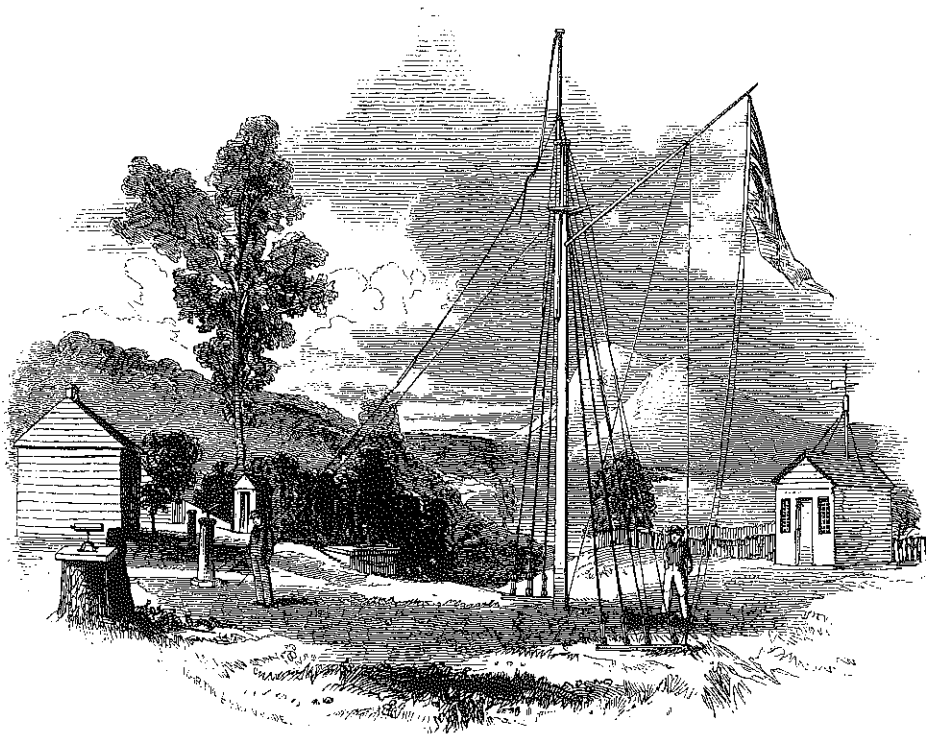


Figure 2.

Rossbank Observatory. Attributed to Thomas Bock (1790–1855). Oil in the Tasmanian Museum and Art Gallery, Hobart. The picture shows the three Captains, Ross (right), Crozier (centre) and Franklin (left) with Kay to the far left. It looks towards Mount Direction. $17\frac{3}{4}$ in. (45·3 cm) $\times 31\frac{1}{4}$ in. (79·5 cm). Bock was transported to Van Diemen's Land in 1824, receiving an absolute pardon in 1833. He worked as an engraver, portrait painter, teacher and later photographer in Hobart. The painting formed part of a major bequest of Sir John and Lady Franklin MSS by the Misses Jessie and Louisa Lefroy to the Scott Polar Research Institute, in 1948. It was donated by the Institute in the same year, to the Royal Society of Tasmania and later transferred to the Tasmanian Museum and Art Gallery. Eve Buscombe* provides notes on the picture and its commission. Whether it was the picture sent to England for Sabine as a gift from Lady Franklin or another, is also discussed. A watercolour sketch for this painting is also in the Tasmanian Museum.

Courtesy of the Director of the Tasmanian Museum and Art Gallery, Hobart.

*'A note about the painting "Rossbank Observatory", attributed to Thomas Bock', *Tasmanian Historical Research Association Papers and Proceedings*, 25 (1), (1978), 18–23, a reference kindly supplied by Mr G. Stilwell.



Rossbank Observatory — Hobart Town.

Figure 3.

"Rossbank Observatory—Hobart Town" by J. E. Davis (engraving). Engraved from one of the watercolours and sketches done during the voyage of H.M. Ships *Erebus* and *Terror* 1839–43 by John Edward Davis (*d.* 1877) Second Master of H.M.S. *Terror* and reproduced in Sir James Clark Ross' *A Voyage of discovery and research in the Southern and Antarctic regions* (John Murray, 1847). This view, looking towards Mount Direction, forms the head piece to Chapter V of Ross' narrative (Vol. I, facing p. 94). $3\frac{1}{2}$ in (9 cm) × $4\frac{1}{2}$ in. (11·5 cm). In her paper about the oil of Rossbank (Figure 2) by Thomas Bock, Eve Buscombe* quotes a letter from Lady Franklin to Captain Ross, about a painting of Rossbank given her by Captain Crozier and just received. "It is one of the prettiest thoughts", wrote Lady Franklin on 28 October 1840 "that ever entered into Captn Crozier's head to send me this memorial— its accuracy as a portrait more than compensates any defects it may possess as a picture". Ms Buscombe tentatively attributes this view to the Rev. R. R. Davies, but it seems more probable that the artist was John Edward Davis, Second Master of H.M.S. *Terror* (Captain Crozier). It may have been the original of the engraving illustrated here, whose attribution to Davis rests on the preface to Ross's narrative (p. xlvii) in which it is stated that the drawings and vignettes in the two volumes were by Davis. The original has not so far come to light.

* A note about the painting "Rossbank Observatory", attributed to Thomas Bock. *Tasmanian Historical Research Association Papers and Proceedings* 25 (1) (1978), 18–23. Lady Franklin's letter is in the Scott Polar Research Institute, Cambridge.

Having established the Observatory and completed their first season's work in Hobart Town, the *Erebus* and *Terror* sailed in November 1840 at the beginning of the southern summer for the Auckland Islands and the Antarctic, leaving Lieutenant Joseph Henry Kay (1815–75) as Director of the Observatory as well as Messrs. Peter Scott and Joseph Dayman, Admiralty Mates, with a Marine from each ship.[16]

[16] Ross (footnote 4), I, 125.

Figure 4.

Rossbank Observatory by F. G. Simpkinson (1819–1906) later Simpkinson de Wesselow (watercolour). Viewed from the East, looking towards Mount Wellington. Painted *c.* 1844. $10\frac{3}{4}$ in. (27·5 cm) × 15 in. (38 cm). The picture has been for many years in the W. L. Crowther Library of the State Library of Tasmania and was identified there recently as depicting Rossbank. Simpkinson was on the Observatory staff from 1844 to 1849.

Courtesy of the W. L. Crowther Library, State Library of Tasmania.

In a despatch to the Secretary of State for the Colonies of 17 November 1840 'relative to the departure of Captain Ross's ships and the establishment of the observatory', Sir John Franklin informed Lord John Russell that before leaving on his Antarctic cruise, Ross

> had the kindness to show me the official instructions which he had given to Lieutenant Kay whom he left in charge of the observatory, which contain a direction for him to apply to me in all cases where he may require advice or assistance. I need scarcely assure your Lordship that either will be most cheerfully given on my part. I know that additional aid will be required on those days which are called Term Days, in order to secure the simultaneous readings of the three magnetic instruments. I shall be happy to attend on those days, and will make a point of procuring the help of other observers.[17]

Franklin was as good as his word, and Ross expresses his gratitude to 'His Excellency and those gentlemen volunteers resident in the colony, who had, on every term day during our absence most zealously devoted themselves to the tedious and laborious

[17] Archives Office of Tasmania, Governor's Outward Despatches, G.O. 36, p. 508.

work'. The table listing the term days and the volunteer observers runs from 27 November 1840 to 25 February 1842, and gives the following names, apart from Franklin's own, many of them well known in the history of Tasmania: Mr. Gell, Mr. Gunn, Lt. Bagot (51st Regiment), Captain Moriarty, R.N., Captain Stanley (H.M.S. *Britomart*), Mr. Nairne, Dr. Bernard, Mr. Henslowe, Mr. Leicester, Mr. Wright, Mr. Jeffery.[18] Ross paid particular tribute in his narrative 'to our excellent friend Sir John Franklin, who not only evinced the most anxious desire, but sought every opportunity of promoting the objects of our enterprise, and contributing to the comfort and happiness of all embarked on it'.[19] Dr. (later Sir) Joseph Dalton Hooker remarked in a lecture given after the return of the expedition that the Lieutenant Governor 'looked upon our ships with a warmer feeling and more interest than he did on all the English Navy beside ... he made it his constant study to treat all hands, both officers and crew, in a manner which showed that his happiness depended on our comfort'[20] As well as taking part in the 'fagging work of observing', he sent fresh fruit and vegetables daily to the ships for the messes of all hands, especially the crews. Franklin's period of office in Van Diemen's Land was not a congenial one and he must have delighted correspondingly more in the visits of the two ships, in one of which, some seven years later, he was to die while searching for the North West Passage.

The vessels returned to Hobart in April 1841 after their operations in the Antarctic, having been the first to penetrate the pack ice of the Ross Sea and to make the remarkable geographical discoveries previously mentioned. The ships' portable observatories were once again put up near the Rossbank Observatory and careful comparisons made between the ships' and the Observatory's instruments. The two sets of ships' magnetometers were observed simultaneously with those of the Observatory on the term days of 21 April, 28 May and 23 June. Sir John Franklin described all the activity to a correspondent as follows:

> Ross & Crozier are still with us—working hard at the Observatory. There are now two separate sets of the magnetical instruments under hourly observation and on Term Day every $2\frac{1}{2}$ minutes—and it is truly beautiful to witness the accordance on these instruments. The slightest change either in intensity or direction is thus exhibited and registered—together with the Pressure and temperature and state of the Atmosphere—as well as other indications of those of other Instruments which have been directed to be noticed. Ross has Whewell's pendulum going—the Transit Instrument fixes for every passing Star and his telescopes ready for all the other observations as they occur and the weather permits of being observed. You can imagine my delight at having all this going forward so near to me that I can walk or ride out in a few Minutes which I do almost daily—and on Term Days when an increased number of observers is required to keep the watches—I have the pleasure of being enlisted into the service'.[21]

On 7 July 1841, the *Erebus* and *Terror* weighed and stood down the River Derwent, for the second and last time. Sir John Franklin and other friends came on board to 'bid

[18] Ross (footnote 4), II, 3.

[19] Ross (footnote 4), I, 129.

[20] Royal Botanic Gardens, Kew, Hooker MSS. Volume lettered 'Antarctic Expeditions 1842–1901'. Text of lecture by Joseph Dalton Hooker given at the Royal Institution of South Wales, 17 June 1846.

[21] Mitchell Library, Sydney, ref. A.75, Franklin–Buckland Correspondence. Letter to the Reverend Dr William Buckland, F.R.S., dated 21 May 1841.

a long farewell'. Ross again remarks in his book upon the hospitality and friendship experienced from the inhabitants of Van Diemen's Land, 'our southern home'. After the ships' departure, Franklin wrote as follows to Sir William Hooker, father of the expedition's Assistant Surgeon and Botanist, Dr. Joseph Dalton Hooker:

> It is fortunate that the position of V.D. Land was more favourable for the series of observations which Ross had to make than any other in this Quarter—and thus he was enabled to follow his own inclination and afford us the highest gratification by staying longer here than he could have at another place. This family feel identified with the Expedition and I have the satisfaction of knowing that the whole Colony entertains a very lively interest in its success and in the welfare of the commander, officers and crew. The magnetic observations of the stationary Observatory are highly interesting and I am sure the most important results will be obtained from their analysis. No persons could be more sedulous and accurate than are the three officers, Lt. Kay, Mr. Scott and Mr. Dayman who make and register them.[22]

Franklin also wrote in similar vein from Government House on 20 August 1841 to Sir John Barrow, Second Secretary of the Admiralty:

> I have been made very happy by the selection of this place for the Magnetic Observatory and that Ross has in consequence made it his Head Quarters; we have therefore had the pleasure of seeing much of him and Crozier—and it is truly interesting to see them together. The same spirit animates each. Ross directs with all his forethought, knowledge and judgement—the other joins him most cordially in every operation—and the execution of their orders is promptly and cheerfully carried out by the officers and men. Such are the persons who must succeed—if human effort and skill can attain success... The officers of the Observatory keep assiduously and steadily at their work—and very important will be the result of their labours to Magnetic Science. I look forward with confidence to the development of many new features connected with the question of magnetism, when their observations have undergone a careful analysis. I see in them much that tends to confirm opinions I had formed from the Registers kept on my Polar Voyages respecting the influence which atmospheric changes produced on the needle and also regarding the Lunar Motion, but which in the then imperfect state of my knowledge of the intricate questions bearing on Magnetic Science, I did not venture to put forth in my published narrative so fully as my own notes would have furnished...[23]

During the first few months of the Observatory, a building had been erected for the accommodation of the staff at a cost of £132 2*s*. 3*d*., which was sanctioned by Lord John Russell, Secretary of State for War and the Colonies, in a despatch dated 9 May 1841, the sum to be repaid 'to the Commissariat Chest of the Colony by the Lords Commissioners of the Treasury from funds at their disposal'.[24] Further expenses were paid by the Commissariat and charged to the Admiralty for the insulation of the

[22] Royal Botanic Gardens, Kew. Hooker MSS. LXXII, Australian letters No. 157, dated Government House 6 August 1841.

[23] Archives Office of Tasmania. Governor's letterbooks, G.O. 52.8. See also Franklin's *Narrative of a Journey to the Shores of the Polar Sea*... (London, 1823) and his *Narrative of a Second Expedition to the Shores of the Polar Sea*...(London, 1828).

[24] Archives Office of Tasmania, Governor's Inward Despatches, G.O. 1.42.

Observatory, for the erection of a wooden shed over the spot selected for a series of experiments to measure the temperature of the soil at different depths and for an addition to the cottage built for the officers. One of the volunteers, Mr. Samuel Jeffery (later to become Superintendent of Kew Observatory), was appointed as an assistant at a salary of £150 per annum in September 1842 by Sir John Franklin, with Admiralty approval.[25] Kay based his request for an additional member of staff in a letter to the Lieutenant-Governor, on the following reasons:[26]

1. To enable myself as Director to bestow more time and attention to the delicate, miscellaneous observations and to the numerous calculations and reductions, required by the instructions of the Royal Society...
2. To enable me from time to time to relieve Messrs. Scott and Dayman ... from the laborious duties which they have performed for the last two years in concert with myself, the close application necessary to carry out the *hourly* system of observation ... not affording time for relaxation of any kind to enable us to take recreation or the necessary exercise for the preservation of health, in such sedentary employment, and which if persevered in, will I fear, materially affect the health of the persons so engaged.

(Following the Royal Society's Instructions, no observations were made on Sundays.)

During part of March 1843, a daily journal of remarks and observations was kept at the Observatory of the passing comet, as seen from Van Diemen's Land. Extracts from these observations were communicated by Sabine on Kay's behalf to the Royal Astronomical Society of London (Kay, 1845). While Kay and his staff were observing the comet on dry land at Rossbank, their former shipmates were recrossing the Antarctic Circle for the last time, in long. 13°30′W. At 9 p.m. on 10 March 1843, 'a remarkable ray of light between two dark clouds' was seen from the *Erebus* and *Terror*, entered in the log-book of HMS Erebus as a 'stationary beam of Aurora Australis, bearing west and inclined in an angle of about 45° to the southward'.[27] Its fixed character at length assured the expedition that this motionless ray must be in fact the tail of a comet. Sir James Clark Ross remarks in his narrative that the comet was not seen in Europe until 17 March 1843, where Sir John Herschel published the earliest notice, designating it as a 'Comet of enormous magnitude in the course of its progress through our system, and at present not far from its perihelion'.[28]

In the first published volume of results from Rossbank (1850), the provision of further insulation and the erection of a detached observatory are described as follows:[29]

> In May 1843, the instrument room of the Observatory was divided by a wooden partition, running along its whole length, and was lined 'with blankets stretched tightly on each side of the uprights firmly fixed to the floor and ceiling, at 16 inches from the inner sides of the chamber, the interval between the two parts of

[25] Archives Office of Tasmania, Governor's Inward Despatches, G.O. 1.50.

[26] Archives Office of Tasmania, Governor's Outward Despatches, G.O. 43, p. 804, 16 September 1842.

[27] Ross (footnote 4), II, 368, and Biographical Notes (Appendix 3) for Kay's paper.

[28] Ross (footnote 4), II, 369.

[29] The construction of a stone building to house the new magnetic instruments sent by the Admiralty was similarly authorized by the new Lieutenant Governor in 1844, paid by the Commissariat and forwarded to the Admiralty. The expense of the new buildings and additional accommodation was estimated by the Royal Engineer to be £339 13*s*. 11½*d*. Archives Office of Tasmania, Colonial Secretary's Office, C.S.O. 132, file 2633 and Governor's Outward Despatches, G.O. 50, p. 178.

> the blanket being about $3\frac{1}{2}$ inches, and the blanket itself closely pinned with wooden battens, above and below. Every seam in the wooden sides of the building was made air tight, and earth was banked around the building outside, sufficiently high to prevent the entrance of currents of air between the wooden plates of the building and its stone foundation'. The bifilar and balance magnetometers were also enclosed with a double casing of wood; the interval between the two cases, which was about three inches, being filled with clay. This external casing surrounded, but without touching, the mahogany cases containing the magnetometers, and was supported by uprights fixed to the floor and ceiling, so as to be quite independent of the pedestals on which the magnetometers rested. In November 1844 a detached building for experimental determinations, and for observations of absolute force, was erected in conformity with the directions contained in the Revised Instructions of the Royal Society. It consisted of a single hexagonal room 13·5 feet by 10·5 feet, with sandstone walls and a weather-boarded roof.[30]

Each side measured 14 feet. This detached observatory, which still stands, 'was placed at a considerable distance from the large observatory, to avoid any possible influence of the magnets upon each other, the smallest distance between any one instrument in the large observatory and any one in the small observatory was 77 feet. The stone magnetometer-pedestals were so arranged with respect to height that the magnets, when suspended and in adjustment, should be in the same horizontal plane...'[31]

In 1844, Lieutenant Alexander Smith, R.N., and Mr. Francis Simpkinson, Admiralty Mate, succeeded Lieutenants Scott and Dayman. By 1847, the Director of the Observatory found his long residence in Tasmania and monotonous work extremely tedious and bemoaned the 'absence of all intellectual pursuits' in the young Colony. Writing in September of that year to Sir John Franklin (who had in fact, through the irony of fate, died three months before in the Arctic on board H.M.S. *Erebus*), Kay said that Sir James Clark Ross had behaved very badly in making little effort to get him promoted. He also felt that he had been done an irreparable injury in being kept so long away from his profession.[32] He expressed some of this discontent in a letter to Ross himself of December 1847, on receipt of a copy of the narrative of the Antarctic voyage. He was pleased, nevertheless, with 'the tone of satisfaction' in which his own conduct and endeavours were described, despite being denied 'reward of another nature'. He continued as follows:

> I am happy to be able to report favourably of the observatory and that all the work as you planned and arranged it, proceeds with the greatest regularity. But I cannot conceal from you that beginning with myself all are tired and weary of the continued and unvarying routine day and night, without any cessation. I have now completed $7\frac{1}{2}$ *years of observatory work with hourly observations* and am become very much of a machine wound up to go to Gottingen mean time.[33]

Kay asked in the same letter for a recall, pointing out that each succeeding year made it more difficult to take his place in the Navy again. In entreating Ross from the bottom of

[30] *Observations Made at the Magnetic and Meteorological Observatory at Hobarton*, 2 vols (London, 1850–2), I, x.

[31] Footnote 30, II, xv.

[32] Scott Polar Research Institute (Cambridge) MSS 248/431.

[33] Scott Polar Research Institute (Cambridge) MSS 1226/15.

his heart, the Director confessed that 'the monotony of the pursuit has at last conquered my determination not to express or allow that I felt fatigue and it has fairly beaten me'. Hourly observations were stopped the next year, when Simpkinson returned to England.

On 11 July 1849, Kay read a paper to the Royal Society of Van Diemen's Land[34] on tests made by him during an ascent of Mount Wellington of the first aneroid barometer to reach Tasmania, which had been entrusted to his care by a Dr. Kenworthy. He compared it with the mercurial instrument at the Observatory. In 1850, a night watchman was appointed with wages at the rate of £1 per week after one of the Observatory buildings 'had been feloniously entered and several articles stolen therefrom'.[35] Kay's letter of 31 October 1850 to the Colonial Secretary reported the loss of a telescope, two small mirrors and a stirrup belonging to one of the magnetometers. 'The thief (or thieves) left a stone tied up in a stocking behind him, which it may be presumed was intended to knock anyone on the head with, who might have interfered with him . . .' Kay pointed out, in a request for more effective police protection, that 'in five minutes the labour and expense of years might be destroyed' and that the Observatory was 'surrounded by bad characters'. Amongst these was a road party of felons 'at work on the hill above us, within 200 feet of our fence, and overlooking the whole establishment'. In addition, a party of workmen was building the powder magazine close at hand. Another party was in the quarry, 'besides the usual establishment of men attached to the government garden'. Such were the hazards of maintaining a scientific establishment in Van Diemen's Land, then still receiving convicts under the transportation system. Further repairs to the Observatory buildings and officers' quarters and the erection of an additional two rooms and a kitchen in stone for Kay were authorized in 1850,[36] to be paid out of the military chest and repaid by the Admiralty. The establishment was however reduced in 1851 to Commander Kay and Mr. Samuel Jeffery alone.

In December 1852, Kay communicated to the Royal Society of Van Diemen's Land[37] the results of numerous observations and calculations made for determining the geographical position of the Observatory '*at present*' as Lat. 42°52′13.7″ South, Long. 147°22′06″ East. The trigonometrical survey of the island was then in progress during the summer months. Kay maintained that once a well defined spot like the Observatory were connected with the net of triangulation, it would be possible to determine the position of any other place with equal accuracy. It would then follow that the disgrace would be removed 'of having our principal head-lands (on the only chart of Tasmania which at present exists) laid down *miles in error* in latitude, to say nothing of their error in Longitude'. In 1853, the Admiralty (probably owing to the expenses and exigencies of the Crimean War) decided to relinquish the Observatory and to transfer to the Colony the most important instruments, on the condition that a competent person should be employed to continue certain observations. In a memorandum of 21 January 1853,[38] the Lieutenant-Governor, Sir William Denison, stated that it was very desirable to maintain the Observatory 'if not for the express purpose of continuing the series of magnetical observations, yet at all events for the purpose of combining these

[34] Kay (1851), see Appendix 3 for list of Kay's publications.

[35] Lieutenant-Governor W. Denison to Earl Grey, Secretary of State for the Colonies, 10 December 1850. Archives Office of Tasmania, Governor's Outward Despatches, G.O. 72, p. 854.

[36] Archives Office of Tasmania, Colonial Secretary's Office, C.S.O. 133, file 4274.

[37] Kay (1852–54A); see Appendix 3 for list of Kay's publications.

[38] Archives Office of Tasmania, Colonial Secretary's Office, C.S.O. 24. 213, file 8088.

with others of a more directly practical character', for example the 'determination of time with such accuracy as may enable the Masters of vessels to rate their chronometers'. In a homeward despatch of 14 April 1853,[39] Denison stated that he had asked Kay to name a competent person to carry out observations and that it was proposed to 'connect the Observatory with the Survey Department, giving general charge to Captain Hawkins, who has just arrived here in command of the Sappers employed in the Survey, and paying the salary of the observer and such contingent expenses as may be required out of the Land Fund', at a cost of no more than £250 per annum. Denison also wished to connect the Observatory with the general triangulation of the Colony 'now progressing', to be carried across the Bass Straits to the mainland. This was agreed by the Secretary of State and Mr. Jeffery was appointed Superintendent under the Colonial Government at a salary of £250 per annum, plus quarters, 'to carry on the duties temporarily, pending instructions to His Excellency from the Secretary of State respecting the maintenance of the establishment'.[40] The night watchman was awarded an increase of 25 per cent because of inflation caused by the Gold Rush.

Kay was recalled to England, and he asked Lieutenant-Governor Denison in a letter dated 24 January 1853[41] for compensation from the incoming tenant (Captain Hawkins of the Survey Department) for the private improvements to his house: a two-stalled stable and loft, coach house, fowl house, fowl yard, pig stye, wood shed, laundry, fencing for kitchen and flower garden, fruit trees, plants and flowers, papering of dwelling apartments, grates for same, bells, fittings of large water tanks with cocks etc. 'The fruit trees and plants', he wrote, 'are young, having been planted only in 1850 and many of them will next year be bearing—they include almonds, cherries, plums, pears, apples, a vine, strawberries, currants, gooseberries and raspberries, which latter you kindly gave me. There is an asparagus bed only two years old, and the flower garden contains some good plants, bulbs and trees'. The Director of Public Works (William Porden Kay, his brother) valued the items at £147, which was allowed. Kay left the Observatory on 31 March 1853. Some years earlier (in 1846) he had been elected a Fellow of the Royal Society of London for his work on geomagnetism. He made his later career in the public service of the State of Victoria, Australia.

The newly appointed Superintendent of the Observatory, Mr. Samuel Jeffery, one of the voluntary observers of earlier days and later paid assistant, was instructed to make daily observations at eight-hour intervals (6.10 a.m., 2.10 p.m. and 10.10 p.m.) of the declination magnetometer, the induction inclinometer and its thermometer, the bifilar magnetometer and its thermometer, the vertical force magnetometer and its thermometer, the barometer and its thermometer, dry and wet thermometers, directions and force of wind, quantity of rain, extent of cloudy sky in tenths, weather, maximum and minimum temperature in the twenty-four hours by the self-registering thermometers. He was also to make observations for time, as frequently as the rates of the chronometers might require—every five days on five stars. At 9 a.m. on Tuesdays and 3 p.m. on Fridays, he was to make observations of magnetic inclination; on Wednesdays, observations for the determination of the absolute horizontal intensity at

[39] Archives Office of Tasmania, Governor's Outward Despatches, G.O. 78, pp. 791–9.

[40] S. Jeffery to Admiralty, 8 July 1854. Enclosure in Archives Office of Tasmania, Governor's Outward Despatches, G.O. 80, 1854.

[41] Archives Office of Tasmania (footnote 38).

three deflecting distances in conjunction with readings of the large bifilar magnetometer. The collimator magnets, with the small declination instruments, were to be employed repeatedly until Mr. Jeffery was satisfied with the correctness of 'the constants' assigned to the large declination instrument of the Observatory.[42]

Not surprisingly, Jeffery applied to Sir William Denison on 10 May 1853 for an assistant at £60 per annum in case of sickness, as there was 'no provision for maintaining unbroken the series of observations, both magnetical and meteorological which are now recorded at fixed and regular periods' in concert with the European observatories.[43] His very reasonable request was refused on the grounds of unjustified expense: occasional assistance could be obtained when necessary. However, worse was to come, as far as Mr. Jeffery was concerned. It was decided to close the Observatory altogether. In a despatch from Government House, Van Diemen's Land, dated 11 July 1854[44] to the Duke of Newcastle (Secretary for War and the Colonies), the Lieutenant-Governor, Sir William Denison, wrote as follows:

> My Lord Duke
>
> In a despatch No. 77 dated 14 April 1853, I brought under the notice of Sir John Pakington, the correspondence which had taken place between Captain Kay, R.N., the Director of the Magnetical Observatory at Hobart Town, and the Government relative to the transfer of the magnetical instruments to the Colony and I proposed that the establishment should be maintained at the expense of the Land Fund. To this proposition Your Grace was pleased to accede in a despatch no. 165 dated 6th November 1853. The object which I had in view in recommending the retention of the observatory was not so much the continuance of magnetic observations, in which it is obvious that the Colony can have but little interest, as the establishment of a permanent observatory which irrespective altogether of the benefit which would accrue to Science generally from observations made at a point so far to the south of the equator, would be beneficial to the Colony in many ways. As I understand however that there is not much probability at present of the establishment of a permanent observatory here, and as the claims upon the Land Fund are increasing daily, I have thought it advisable to notify Mr. Jeffery, the Superintendent of the Observatory, that his services will not be required much longer—and I propose, should I not receive instructions to the contrary, to discontinue the magnetical observations, and dispense with the services of Mr. Jeffery at the end of the present year.

The Lieutenant-Governor enclosed a communication from Mr. Jeffery to the Admiralty 'with an expression of my hope that their lordships will take a favourable view of Mr. Jeffery's claim, he having served zealously and faithfully, not only while under the command of Captain Kay, but also during the time that he has had sole charge of the observatory'. Denison would 'cause the instruments to be carefully packed up by Mr Jeffery' and would await instructions as to their disposal. Jeffery's memorial of February 1853 to the colonial authorities, requesting further employment, had been supported by the Admiralty and Sir Francis Beaufort, the Hydrographer of the Navy, who wrote on 12 July 1853 'I think I never reported on a case which seems more legitimately to call for the protection of their lordships, the more so as the

[42] Archives Office of Tasmania, Lands and Survey Department, L.S.D. 1.96.
[43] Archives Office of Tasmania (footnote 38).
[44] Archives Office of Tasmania, Governor's Outward Despatches, G.O. 80.

Commanding Officer in Tasmania and Col. Sabine (to whom all his observations have been referred) alike bear witness to unremitting zeal and ability'. Both petitions summarized Jeffery's employment and conditions of work from September 1842 onwards. That of July 1854 asked that he might be 'granted the pension accorded to persons whose employment have ceased through accomplishment of the objects for which their employment was instituted'. The negative reply to this last is to be found in the Governor's Office inward despatches:[45]

> I am commanded by their Lordships to acquaint you ... that, as Mr. Jeffery was employed in a position to which no pension was attached, they have no power to confer such a pension on him.

Such was Mr. Jeffery's devotion that he offered on 19 December 1854 to carry on voluntarily experiments once or twice a week to determine 'magnetic terrestrial force' at the Observatory. In a long letter to the Colonial Secretary[46] enclosing the returns for 1853, he emphasized the importance of Tasmania as a magnetic observatory, because of its nearness to the focus of maximum intensity for the southern hemisphere, similar to that of northern Canada in respect to the northern hemisphere. He further remarked that 'there has been found to exist a peculiar resemblance, in the converse order between the changes shown by the magnetic instruments at the Toronto Observatory and at Hobarton at similar periods of local time; this station being at nearly opposite points of the globe both geographically and magnetically. So nearly is this the case in the latter sense that the curves of the diurnal range of the variation at the one position, when inverted, almost correspond with those of the other'.

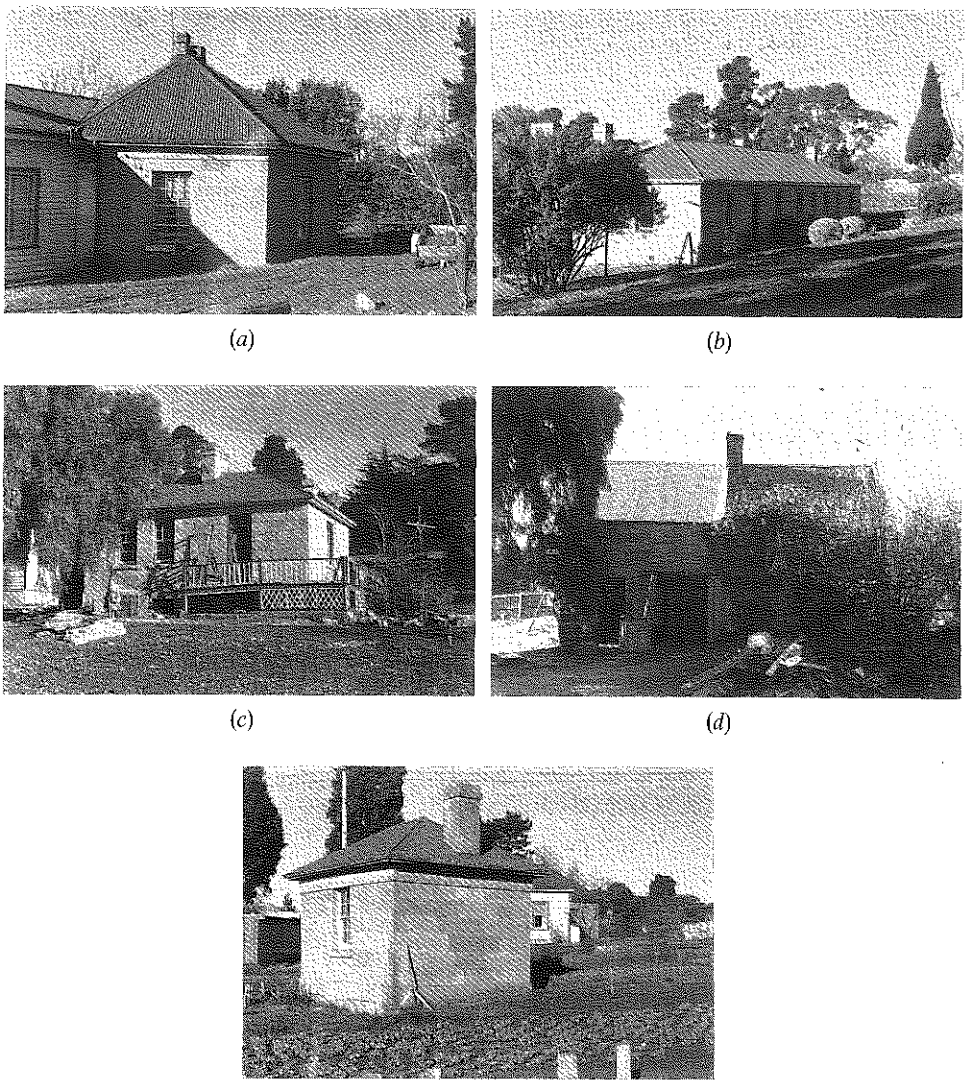
Mr. Jeffery pointed out that the Toronto Station was supported as permanent by the Government of British North America. He quoted from Colonel Sabine's second volume of published results in saying that the exact determination of the absolute values of the magnetic intensity at Hobart was of the more importance, because it had been the base station of the great part of the vessels employed in the magnetic survey of the higher latitudes of the southern hemisphere. He also maintained that 'members of science' in England wished the Observatory to become permanent, perhaps supported by the Colony in connexion with a college. Even the previous year a letter from Sabine to Kay in England had hoped that operations would be continued. This letter also bore reference to him and 'spoke of the effect of the present war in causing Her Majesty's Government to forego its intention at present of establishing a large reflecting telescope in the Southern Hemisphere, implying that the Magnetic Observatory might be continued in connexion with the astronomical'.

The Superintendent offered to carry on without pay a series of experiments 'in order to maintain, at least for a time, the intimate connection now existing, in the records of magnetic intensity of this part of the globe'. He hoped that the end of hostilities might lead to support from the home government for astronomical and magnetic observatories. The expense of the instruments, the cost of apartments for them, the example of Toronto, the 'infancy of our acquaintance with the mystery of magnetism' were all reasons which might induce the Colony to maintain the Observatory. The acceptance of his offer to continue weekly observations voluntarily, he maintained, would mean retention only of the instruments and not of the residence, supposing the Governor had other plans for that. He even zealously pointed out the defective state of

[45] Archives Office of Tasmania, Governor's Inward Despatches, G.O. 1.99, p. 267–70.
[46] Archives Office of Tasmania (footnote 38), No. 36.

the anemometer after fourteen years' wear (an exception to the otherwise good condition of the meteorological instruments) and forwarded a catalogue from the Great Exhibition illustrating a new type, in case the Governor wished to replace the old one, commenting at the same time on other types in use at Greenwich and in Scotland.

It is sad to record that this offer of voluntary service was rejected. In a draft letter to Jeffery dated 20 December 1854, the Colonial Secretary maintained that the observations were only of indirect benefit to the Colony and that Sir William Denison



(*a*) (*b*) (*c*) (*d*) (*e*)

Figure 5.

Observatory buildings, kindly photographed in 1960 by Mr Geoffrey Moseley for this study. The identifications are tentative, since so far no contemporary plans of the site have been located. (*a*) Detached hexagonal observatory erected in 1844. (*b*) Officers' quarters. (*c*) Director's cottage. (*d*) Coach house and stables. (*e*) Outbuilding.

would not be justified in accepting, since the Colony would have to be responsible for the instruments. He wished these to be carefully packed up for forwarding to England. The Secretary concluded by saying 'Sir William Denison desires me to express to you his sense of the industry and intelligence with which you have performed the arduous duty of conducting single-handed the observations for the last two years, and of that zeal for science which has prompted the offer contained in your letter'.

The Rossbank Observatory at Hobart, Tasmania, was thus finally closed down on 31 December 1854. More than a century later, a commemorative plinth was constructed in the Royal Botanic Gardens, Hobart, and unveiled in August 1968.[47] In the grounds of Government House, the hexagonal observatory, the officers' quarters, the old coach house and stables and an outbuilding, each built of stone, are still upstanding (Figure 5). In recent years, some have been restored and are largely used as dwellings. Their pleasant gardens recall that planted by the Director of Rossbank so many years ago.

### 3. The instruments

In their 1839 Report,[48] Gauss and Weber described the 'standard' observatory then in use, and this probably served as a guide for designing prefabricated buildings sent out to the Colonial Observatories. Ideally, the buildings should stand on non-magnetic rock. (On some sites—the basaltic mid-Atlantic island of St. Helena, for example—this was not possible.) The building should be made of timber, with all its fastenings and fittings made of copper. Gauss recommended a meridian axial length of 11 metres, the width being less critical (Figure 6). The Observatory should be well-lit and free from draughts, with double doors and windows if necessary. There should be solid foundations to support the clock, and a theodolite able to sight upon some distant object of known azimuth. These two items, which were both likely to contain a small mass of iron in their consitution, were to be kept some 5 to 6 metres from the magnetometers. Outside the building no large or long iron masses, such as rails, should come within 33 metres of the area around the observatory.

A room such as that shown in Figure 6 would serve for measuring the absolute and relative values of the declination and intensity. While inclination measurements were made, other measurements had to be interrupted, so it was best to use another room or building. For observations of declination *change* (not *absolute* values), the quantity of iron nearby was immaterial, provided that it was not moved during the series of observations.

A modest lack of sensitivity may be acceptable in portable instruments since it has the effect of obscuring daily and seasonal fluctuations while leaving clear those due to the progress of the instrument across the globe, on voyages or expeditions lasting a year or more. At the Observatory, however, it was another matter, for errors had to be kept below the smallest anticipated variations. Strict control was therefore exercised over the instruments, their setting-up and maintenance, and the manner in which observations should be made and recorded.

The establishment of Gauss' *Magnetische Verein* within Europe encouraged the design of a suite of standard magnetometers which could be constructed by any competent instrument maker. The nature of the required observations, and the

[47] *Mercury* (Hobart), 3 November 1965 and 21 August 1968.

[48] C. F. Gauss and W. Weber, 'Results of the Observations Made by the Magnetic Association in the year 1836' Translated in *Taylors Scientific Memoirs*, 2 (1841), 20–42.

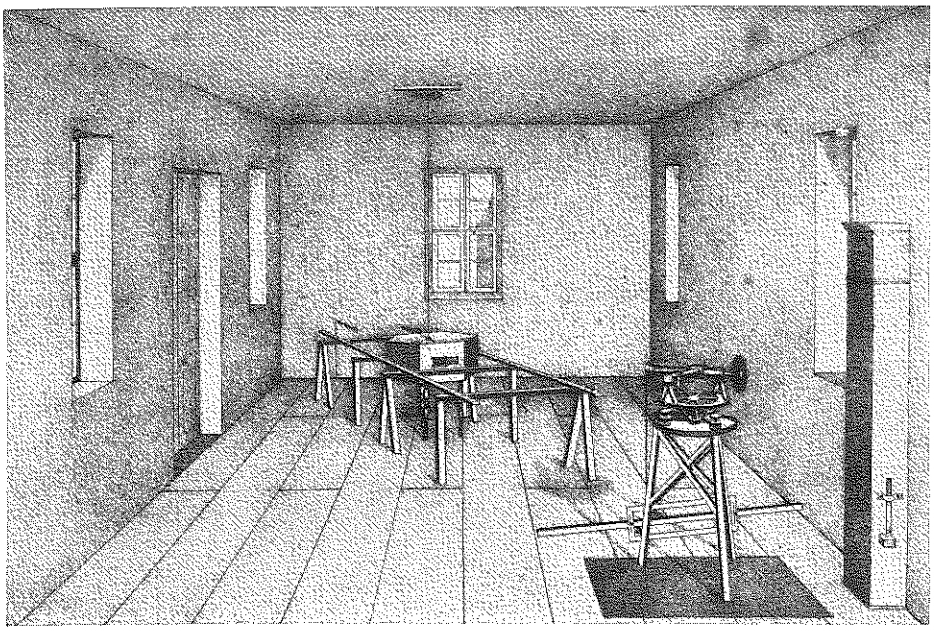


Figure 6.
The Magnetic Observatory, Göttingen. *Taylors Scientific Memoirs*, 2 (1841), Plate II. Science Museum Photograph 519/81.

permanency of the installations, gave rise to observatory instruments differing from those carried on expeditions by land or sea.

The Colonial Observatories were issued with magnetometers which, though clearly derived from those recommended by Gauss,[49] had been modified by Humphrey Lloyd of the Dublin Magnetic Observatory.[50] The elements normally measured to ascertain the Earth's magnetic field were declination, dip and intensity. At the observatories however, the field would be determined from measurements of vertical force, horizontal force, and dip. From these values the total force and the declination could be calculated. It was hoped that this novel approach would allow for greater precision, essential if very small changes were to be detected with assurance.

The three magnetometers as hereafter described in the Royal Society *Report*[51] did require some alterations in order to enhance their performance. Those specific to Hobart are mentioned later. The principal magnetometers were exhaustively described in the *Report* as they were common to all land stations; a summary must suffice here.

The essential features of the *declination magnetometer* (the right-hand instrument in Figures 7 and 8) were the bar magnet, 15 inches by $\frac{7}{8}$ by $\frac{1}{4}$ thick, and its single suspension of fibres of untwisted silk, enclosed in a draught-proof box. The pattern of this instrument resembled that constructed by Jones of London for Dublin Observatory,[52] but built to a considerably larger scale. The magnet and its unifilar suspension were

[49] Footnote 48, 25–42.
[50] *Proceedings of the Royal Irish Academy*, 1 (1841), 163–6 and 330–5.
[51] *Report of the Committee* ... (footnote 2), pp. 13–33.
[52] *Proceedings of the Royal Irish Academy*, (footnote 50). The needle of this magnetometer was 12 in. long.

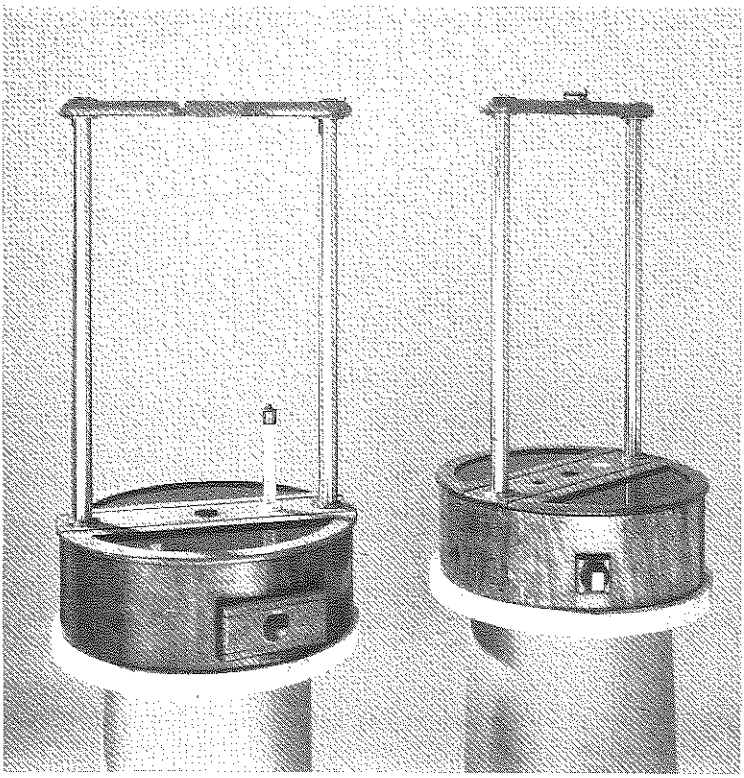


Figure 7.
Magnetometer frames and casings. Left, bifilar; right, unfiliar. Science Museum Photograph 517/81. Crown copyright.

enclosed to protect them from draughts, the thread being led through a glass tube and the magnet swinging within a circular wooden box. Sliding on the magnet, two gunmetal fittings carried the scale and an achromatic lens, forming a moving collimator. Glass panels in the box admitted light to the scale and enabled it to be read by a telescope placed on its own pedestal 8 feet away.

Sundry fittings were also provided: a dummy bar and collimator for straightening the thread, a second magnet of the same dimensions as the first, to be used in measurements of absolute intensity, and a copper damping-ring. This declinometer came into use in September 1840, being observed each hour, Göttingen Time. The original thread lasted until July 1843 when two fibres broke and the remainder soon gave way. Its replacement lasted until the hourly series ended in 1848.

The *horizontal force magnetometer* (the left-hand instrument in Figures 7 and 8) was the same size as the declinometer. The magnet lay at right angles to a bifilar suspension whose two silver wires had their plane in the magnetic meridian. The horizontal component of the Earth's force caused the magnet to twist these wires and to take up a position of rest such that the horizontal force was equal to the bifilar's resistance to torsion. The horizontal force was variable while the plane of detorsion was constant; hence any change in the former caused the magnet to turn through an angle until the opposing forces were again equalized. This angle was used to compute changes in the

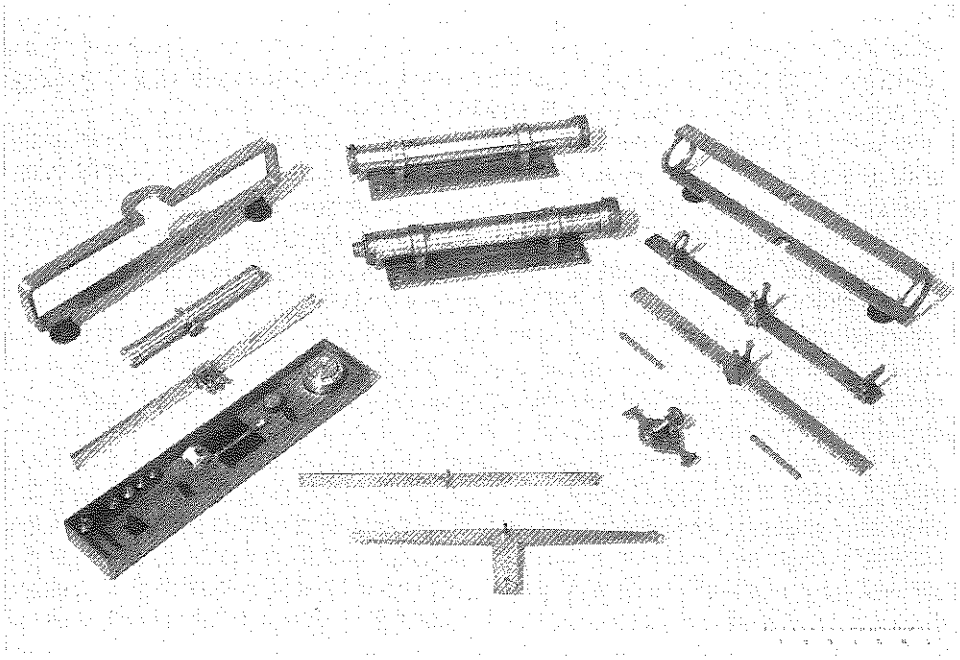


Figure 8.

Magnetometer fittings and accessories. Left, top to bottom, bifilar copper damper, telescope, magnet, box of weights etc. Centre top, observing theodolite telescopes; bottom, balance magnetometer needles. Right, top to bottom, unifilar copper damper, magnet and dummy, thread suspension frame. Science Museum Photograph 518/81. Crown Copyright.

horizontal force field. With the aid of a second magnet the apparatus could be adapted to find the *absolute horizontal intensity*.[53]

The instrument used to determine the vertical component of force was a *balance magnetometer* consisting of a magnetic needle resting by knife edges on agate planes and brought to a horizontal position by weights. From the changes in position of a needle so balanced, changes in the vertical force may be inferred when we know the mean inclination at the place of observation and the times of vibration of the needle in the horizontal and vertical planes. The magnetic needle, 12 inches long, carried a wire cross at each end attached by a copper ring, distance between the crosses being 13 inches. It rested on agate planes which, through a solid copper support, were fixed to a massive marble base. The needle, which could be lifted off the planes, was balanced by screwing small brass counterweights along an attached cross-piece. The position of the needle was observed through micrometer microscopes on the base of the instrument.

Considerable temperature variations were felt inside the Observatory and led to the construction of a second roof, which however failed to stabilize conditions. In May 1843, a partition was erected in the instrument room, the walls insulated by stretched blankets, and the exterior made more air-tight by means of earth banked around the

[53] The magnetometer issued to Ross for the Antarctic voyage, since it was expected to register extreme values when near the Pole, was provided with a means of observing such values, matching the declination magnetometer; see also Correspondence, Kay to Franklin: Archives Office of Tasmania, C.S.O. vol. 78 file 1746, 15 February 1843 and vol. 83 file 1893, 29 May 1843.

wall footings.[54] At the same time the bifilar and balance magnetometers were surrounded by double wooden cases. These enclosures were carried on their own uprights secured to floor and ceiling independent of the existing mahogany cases, the three-inch gap between them packed with clay.

In 1839, just before the magnetometers were despatched in H.M.S. *Erebus* and *Terror*, argument had arisen regarding the magnetization of their bars. Correspondence in the *Times* newspaper, some of it regrettably anonymous, revealed that the method used had not received universal approval. The first letter, dated 26 December 1839,[55] is signed 'Cui Bono'. Its writer had discovered that the bars, made in Dublin, had been sent to London and there magnetized by the aid of a 'voltaic magnet' i.e. by electric current. He claimed that the result would inevitably be a multi-pole magnet, useless for terrestrial magnetic observations. Should all the magnetometers destined for the Colonial Observatories have been provided with similar magnets, the exercise would be fraught with errors.

Dr. Lloyd saw the letter some weeks later, on his return from the Continent. His response, dated 6 November,[56] was short but detailed. Two bundles of steel bars had indeed been sent to two different craftsmen in London, as Grubb had no magnet powerful enough for the task. On receipt one set was found to be imperfect and had been returned to London to the craftsman who had successfully magnetized the other set. All the magnets were then tested and found satisfactory; two were in constant use at the Dublin Magnetic Observatory and had proved excellent. A high degree of directive power was all that was required of these magnets and this they had. The supposition that they were rendered imperfect by consecutive poles was nonesense and Cui Bono's ignorant suggestion unjustified. The Royal Society had tested magnets created by electromagnetic fields and had been satisifed with their behaviour.

To this letter the Editor appended one from the instrument-maker E. M. Clark which, dated 18 September, was presumably the authority on which Cui Bono based his accusations. Clark was noted for magnetic apparatus of various kinds and had in fact built the 'voltaic magnets' at the Adelaide Gallery and the Polytechnic Institution which had magnetized Grubb's bars. These he regarded as mere philosophical toys, incapable of producing magnets of true polarity. In addition Clark stated that Grubb had used shear-steel, a form of metal less retentive of magnetism than cast steel.

Cui Bono immediately took up his pen in reply. On 15 November[57] a lengthy and querulous letter was printed, taking exception to Dr. Lloyd's explanation and accusing him of obscuring the true facts. However, by expanding on his list of complaints to include the form of magnets and the manner of their suspension, Cui Bono revealed his lack of knowledge concerning recent developments in magnetometers, and there the matter rested. In the event, though minor difficulties arose from time to time, the magnetometers gave excellent service despite the variety of climate and conditions in which they operated.

Simultaneous observations at all the Observatories were made with respect to Göttingen Time, where the Headquarters of the Magnetic Union was situated. Regulations demanded that the three magnetometers be read hourly, but as one person

[54] These alterations were also mentioned in *Observations made at the Magnetic ... Observatory* (1850–2) (footnote 30).

[55] *The Times* 26 September 1839, p. 5, col. 3.

[56] *The Times* 6 November 1839, p. 3, col. 3.

[57] *The Times* 15 November 1839, p. 6, col. 4.

could not do this simultaneously the vertical force magnetometer was to be read 2 min 30 s before the hour, the declination magnetometer at the hour, and the horizontal force magnetometer 2 min 30 s after the hour.

One day each month was set aside as a Term Day during which each magnetometer was to be observed at short intervals: the declinometer every five minutes, the other two every ten. This yielded one observation every 2 min 30 s, a total of 576 during the 24 hours.[58] Absolute determinations of dip, intensity, and declination were to be made each month, and the magnetic moment of the bars and the rigidity of the telescopes checked. In addition, in the event of any remarkable phenomena such as aurorae, earthquakes, thunder or high winds, or when the magnets were visibly disturbed, the observing frequency was to be increased. From the data, daily and monthly means would be calculated and annual rates of change measured.

It was Edward Sabine (1788–1883) who organized the Colonial Observatories and supervised the reduction and publication of their results. After practical experience as geophysical observer on John Ross' and Edward Parry's Arctic expeditions, and in the Atlantic, Sabine had joined Humphrey Lloyd and James Clark Ross in the 1830s for the magnetic survey of the British Isles. The Colonial Observatories' programme was handled through the British Association for the Advancement of Science and the Royal Society (in both organizations Sabine progressed through various high offices) and was served by staff and premises at Woolwich, for Sabine was a Royal Artillery officer by profession. Under his supervision the Observatory results were processed at a government-funded clerical establishment, between 1841 and 1861. Lieutenant C. J. B. Riddell (who prepared the Magnetical Instructions published by the government in 1844[59]), and then Lieutenant Younghusband, plus four or five clerks, assisted him up to 1854. The Observatory directors had no part allotted them beyond responsibility for the routine of their establishments and the arithmetical accuracy of the returns transmitted monthly to Woolwich. A general inducement was thus withheld to study the subjects with which they dealt, and their responsibility was lowered accordingly.[60]

### 4. The Observatory results

The observations from Ross' voyage and from the Hobart Observatory in its early years were combined in a magnetic chart covering the southern oceans. This greatly assisted navigation, since by then steamships were plying regularly between Europe and the southern continents. In the long term, after several year's observations had been collected and analysed, came a recognition of the combined cosmical and terrestrial origins of the Earth's magnetic field.

Prior to the mid-nineteenth century, a number of views were held concerning the field source.[61] Some proposed a magnetic field permeating space; others localized it within the atmosphere. To suggest that it came from the Sun implied 'action at a

[58] The effort involved in such intensive use of the instruments was greatly eased by the introduction of continuous photographic recording which began during the 1840s at Greenwich and Kew Observatories.

[59] C. J. B. Riddell, *Magnetical Instructions* (London, 1844).

[60] Anon. 'Memoir of General Sabine', *Proceedings of the Royal Artillery*, 12 (1883), 381–96 (p. 393).

[61] For broadly contemporary accounts of terrestrial magnetism before 1850, see A. von Humboldt (translated by E. C. Otté and W. S. Dallas) *Cosmos*, 5 vols (London, 1858), v, 49–162, and W. Snow Harris, *Rudimentary Magnetism* (London, 1852), part 3, 77–133. For accounts subsequent to the Colonial Observatories era, see E. Walker, *Terrestial and Cosmical Magnetism* (Cambridge, 1866), and H. Lloyd, *A Treatise on Magnetism General and Terrestrial* (London, 1874). Many of the studies referred to in these accounts appeared first in *Philosophical Transactions of the Royal Society*.

distance', an effect not then explicable. A compromise which appealed to several thinkers was that of the so-called 'thermic effect'. The Sun was considered to heat that region of the Earth's atmosphere directly facing it. The warmed air 'refracted' magnetic lines and thus gave rise to the daily and annual oscillations which travelled round the globe. Unfortunately, this theory also required that the magnetic equator should traverse north and south of the geographical equator with the seasons and this, it became apparent, did not happen.

The instruments at Hobart yielded vast amounts of data. A few of the recorded events were so remarkable as to attract immediate notice, but in general the figures had to accumulate over several years in order to indicate the bounds of the normal geomagnetic field. From discussion in the *Results* it is clear that much was learnt by comparing observations from Toronto with those from Hobart, thus highlighting distinctions between northern and southern hemispheres; also by comparing either of these with St. Helena; that is, comparing polar and equatorial phenomena. Analysis revealed both cyclic and irregular activity, some elements common to several sites, others unique to Hobart. Further analysis and comparison with atmospheric and meteorological phenomena confirmed the degree of interaction between Sun, Moon, and internal geomagnetic field, strengthening some previously-held beliefs and destroying others.

Eventually terrestrial magnetism shed much of its mystery and moved into scientific daylight. The value of the first years of recording encouraged governments to maintain permanent observatories around the world. Instruments were improved and standardized. Continuous photographic recording, though it increased the work of analysis, showed up those fluctuations small enough to have slipped through the net of hourly measurements and whose existence had been discovered during the intensive observations of the 'term days'.

Contributions such as these did not come from the Colonial Observatories alone, since, like that at Hobart, they did not all survive as permanent establishments. Nevertheless, the British Empire offered many desirable locations for geomagnetic work, especially within the southern hemisphere, which balanced those set across the vast breadth of Eurasia. Regrettably, the East India Company observatories of 1839 had a disastrous history. The original records of Simla were all destroyed by fire in 1858. Magnetical observations from the other two stations were apparently never sent to Sabine, for he made no comment on them, nor were they ever published. Some meteorological observations were published, but after a lapse of thirty years.[62]

Matters of immediate interest were reported at British Association meetings. In 1841, members learnt that results from Hobart were already being received and passed, first to Professor Lloyd and then to Sabine.[63] Lloyd had already investigated the risk of mutual interaction between the various magnets installed in an observatory and had found it to be negligible.[64] In 1842 the Committee submitted a favourable report to the Association, part of it announcing news of Ross's geographical and magnetical

[62] Anon (footnote 60), p. 394.

[63] 'Report of a Committee ... Appointed for the Purpose of Superintending the Scientific Co-operation of the British Association in the System of Simultaneous Observations in Terrestrial Magnetism and Meteorology', *Report of the British Association for the Advancement of Science* (1841), pp. 38–41.

[64] H. Lloyd, 'On the Mutual Attraction of Permanent Magnets Considered Chiefly in Reference to their Best Relative Position in an Observatory', (Read 11 February 1839), *Transactions of the Royal Irish Academy*, 19 (1843), 159–76; Supplement (read 26 April 1841), Ibid., 249–56. A digest of Lloyd's experiments had been given in *Report of the British Association for the Advancement of Science* (1839) sections pp. 12–14.

discoveries; part telling of the goverment's decision to prolong the observatories' lives to the end of 1845.[65] The first year's work had been after all of a somewhat experimental nature. They reported that the balance magnetometer did not satisfactorily register vertical force and that in its place an induction inclinometer (previously described by Lloyd[66]) was now under trial. Gauss' theories were being re-examined and it was also apparent that the magnetic storms—a list of these was appended—encompassed the entire globe.

By 1843, the results collected by Ross were to hand. Within the southern hemisphere, the field-lines that Gauss had proposed were under serious challenge.[67] Ross had sailed over the place where Gauss supposed the South Magnetic Pole to be; his evidence showed that the pole of maximum dip lay further west, while the general field-lines were more like those of the northern hemisphere than Gauss had supposed. Publication of the observatory results was delayed awaiting exact determination of the temperature co-efficients, for which apparatus had been sent to each observatory. Preliminary analysis of Toronto and Hobart figures brought out their similarity of regular motion, corresponding in local time but contrary in direction. It was now clear that small irregular disturbances could be local whereas large ones spread rapidly, perhaps instantly, round the world.

Sabine was still working on Ross's figures a year later but was already convinced that a double-focus magnetic intensity field prevailed in the southern hemisphere, as it did in the northern. Its foci lay closer together, but it was still recognizable, despite the small number of measurements available from the voyage, and the field had nearly the same values as its northern counterpart.[68]

When the British Association's Committee met in June 1845 they had to consider how the observatories should function after the years of intensive work had run their course.[69] It would be preferable to transfer them eventually to their respective governments. Their survival would thus be ensured, and a continuous record of climatic and geophysical data would be maintained, of benefit locally and to the international scientific community. The Committee formulated a questionnaire on the value of continuing the observations, and on the best sites and instruments. This was sent to everyone participating in magnetic surveys and many of the replies were published in the Association's Report.[70] Most correspondents regretted that, since full figures from the Colonial Observatories had not yet been made public, they could not evaluate the result. However, it comes as no surprise that all agreed that observations should continue but at a diminished frequency. The five or six years of intensive recording had established the short-term (daily) cycles; longer series would doubtless reveal a pattern of annual change. The majority thought that the intruments used prior to 1845 should be preserved in case any queries arose when the results became available. Sabine made a case for continuing observations at Hobart, at a lesser frequency, with the staff reduced to a Director and his Assistant to lower government

[65] 'Report of the Committee . . .', *Report of the British Association for the Advancement of Science* (1842), 1–11.

[66] A description of the inclinometer was included in Lloyd's report of various matters, given to the Irish Academy and summarized in *Proceedings of the Royal Irish Academy*, 3 (1844–47), 298–9.

[67] 'Report of the Committee . . .', *Report of the British Association for the Advancement of Science* (1843), 54–9.

[68] Footnote 67 (1844), 144–6.

[69] Footnote 67 (1845), 1–13.

[70] 'Circular Addressed by Sir John Herschel, on the Part of the Committee . . .' and 'Replies to the Above Circular', *Report of the British Association for the Advancement of Science* (1845), 13–73.

cost. On this basis the Association requested the government to keep Toronto, St Helena and Hobart active until 1848, unless a more permanent arrangement could be made.

In 1850 Sabine brought out the first volume of observations from Hobart[71] with full results from 1841–42 and additional material:

Adjustments, Abstracts and Comments (114 pp)
Observations (349 pp)
Magnetic Inclination 1841–47 (19 pp)
Ross Expedition Term Day Observations (25 pp)
Hobarton Absolute Horizontal Force 1840–47 (11 pp)

The second volume appeared in 1852,[72] containing results for 1843–45:

Adjustments, Abstracts and Comments (114 pp)
Observations (531 pp)

In each volume the Observations were tabulated as follows:

(1) Declination, Vertical Force (from 1842): hourly readings. Horizontal Force and Temperature of the Magnet: every two hours.
Term Day Observations, with Meteorological readings.
(2) Hourly, Daily and Monthly Means of the three magnetic elements.
(3) Meteorological readings.
(4) Inclination: readings twice weekly, twice on each of those days.

Neither magnetic nor meteorological observations were made on Sundays, following normal practice, and the specific Instructions given by the Royal Society in 1840. Some results were plotted as graphs, to show at a glance the annual trend or variation, deviation from that trend being indicated by vertical bars. The apparatus itself was displayed to a wider audience than the visitors at Hobart, for a set of magnetometers was included with the collection of instruments sent from Kew Observatory to the Paris Exhibition of 1855.[73]

In 1857 Sabine reviewed the accomplishments of the Colonial Observatories.[74] Their measurements had far exceeded in scope any made previously by national or private observatories, and consequently their analysis had been immensely time-consuming. The results from any single station were enhanced by comparison with others; hence the study of Toronto and Hobart, at similar latitudes but opposite hemispheres, and the contrast of these two with the equatorial station of St. Helena. Transitory fluctuations could only be detected against the background of regular variation, which required the observations to be continued for several years. Once the erratic disturbances were subtracted, periodic variations and their relation to solar cycles stood out clearly. Some of the magnetic minima however, whose relationship to the Sun's position had been inexplicable, were shown to be the mean effect of occasional disturbances.

[71] *Observations made at the Magnetic ... Observatory* (footnote 30), (1850), I.
[72] Footnote 30 (1852), II.
[73] Letter from John Welsh in 'Report of the Kew Committee', *Report of the British Association for the Advancement of Science* (1855), xxx–xxxi.
[74] E. Sabine, 'On what the Colonial Magnetic Observatories Have Accomplished', *Proceedings of the Royal Society*, 8 (1857), 396–413.

Analysis revealed also the annual inequality resulting from the Sun's direction moving throughout the year. The needle's change had its maxima at the solstices and returned to zero at the equinoxes. That this effect was identical in value and direction in both hemispheres and at the equator was totally unexpected. It refuted the theory, put forward by Arago in 1836, which postulated a thermal effect on diurnal variation, with the consequent existence of a global 'line of no variation'. The 'thermal effect' was demolished further by the discovery of a small variation related to the Moon's position. This too was totally unexpected and though first reported from observations at Milan and Prague, was confirmed by data registered at Toronto, St. Helena and Hobart. Lunar influence did not show the ten-year cycle apparent in the solar changes. From the observed double progression, each 24 hours, the Moon did not appear to possess its own magnetic field, but took up an induction field from the Earth. The amount of variation, however, exceeded that to be expected and until a larger number of observatories could contribute data, no theory could be put forward to account for this.

Periodical variations were more numerous than the Royal Society had forecast. Daily solar and lunar variation had certainly been anticipated, but any connection with sunspot-numbers was unexpected, and it was clear than many disturbances previously classed as 'irregular' were in fact linked to the Sun's passage across the sky. These relationships, which depended on the identification of the most minute changes in value of the elements, had been deduced only by means of the global network since, apart from the sunspot cycle, they all depended on the local time and angle of the Sun and Moon being observed in relation to the amount of variation.

In Sabine's opinion a major contribution to knowledge had been the calculation of Absolute Values, and their secular changes. Analysis of these values would reveal the laws and causes of the Earth's changing magnetic field, and eventually the general laws of terrestrial magnetism. When the Colonial Observatories had been set up; it was assumed that their lifetime was too short to accomplish much in this direction but their extension, albeit brief, had allowed sufficient data to accumulate and theoretical work to proceed.

In summary, every branch of enquiry for which the Colonial Observatories were intended had been not only accomplished, but far exceeded. Observations, Sabine remarked, were not enough; from these the formulation of theory and laws, and ultimately generalizations, must and would proceed. Such tasks of analysis should, in his view, be undertaken by observatory staff, they being best fitted to comprehend the process of obtaining the data in the first place.

Finally, it was desirable to expand the observatory network into other British colonies. Royal Artillery stations were appropriate places to set up magnetic and meteorological observatories and the cost was small: £392 per year, exclusive of publishing the results. Since 1842, the British Association had been standardizing, testing, and issuing instruments from Kew Observatory with commendable efficiency, whereas instruments for the Colonial Observatories had been issued from the Royal Artillery Depot at Woolwich—a 'most unsuitable practice' in Sabine's opinion.

So much for Sabine's remarks in 1857. In the long run, the Royal Society's hopes were realized. The Hobart results, and particularly those of the Ross expedition, contributed to charts showing general magnetic field lines for that epoch. More accurate contours were drawn across areas of the Southern Ocean previously traced only speculatively.

These results, with others from the Colonial Observatories and elsewhere, were the

building-blocks for new theories of terrestrial magnetism. The Adams Prize Essay took as its set subject in 1865 'Terrestrial and Cosmical Magnetism' and the prizewinner, Edward Walker, explained how Sabine's conclusions had led to the formulation of theories currently in favour.[75]

Sabine had demonstrated that the Sun's position, relative to the Earth and Moon, controlled all cyclical variations while its condition, reflected in the sunspot cycle, was responsible for irregular magnetic storms. It remained to discover the cause of *progressive* secular changes: the slow westward drift of the field pattern coupled to the change in certain absolute values, as contoured on the world magnetic charts. In Walker's opinion, these gradual changes were also cosmic in origin. Some claim had been made earlier that four magnetic poles or foci, two fixed and two movable, could be identified. The latter two were now seen to be the product of magnetic induction. Thus, the internal field, as well as the fluctuations imposed on it, were in his belief ultimately of cosmic origin.

Walker's Essay provided source material for many encyclopaedias and textbooks and was thus one of the main channels whereby the bare data from Hobart, as published by Sabine in the Observatory Reports, were introduced into the general geographical knowledge of the later nineteenth century.

### 5. The meteorological results

The first corrected and consistent meteorological observations for the colony were made at Rossbank from January 1841 to December 1854. Tables and remarks for the years 1847 to 1852 were published by Kay,[76] who also published a separate paper on solar radiation in which the actinometer was described and sample results given. The full meteorological results were, of course, included in Sabine's *Results*, as mentioned above. Kay acknowledged that these volumes were mainly concerned with the magnetic work, and he promised that the third volume, still to be published, would 'discuss the peculiarities of the climate of Hobart Town, as exhibited in the extensive series of meteorological observations that have been made'.

This projected third volume never materialized, and it was left to Francis Abbott (1799–1833), watchmaker, amateur astronomer, and meteorologist, to combine the Rossbank results with those from his own private observatory in Murray Street, Hobart Town, where, on the closing down of the Government Observatory, he had continued to make meteorological observations, from January 1855 to December 1860. The work was transmitted to the Royal Society of Tasmania in January 1861, and the whole was published by the Government Printer, Hobart Town, the same year.[77] It was, wrote Abbott, intended 'to supply ... the information desired by the public, and, more particularly, by strangers and those who take an interest in Emigration to Tasmania'. No description of the Rossbank instruments was given, the author remarking in his preface that little need be said of them—'they have long been known to the world, and, when it is considered that they were procured by the Government for a specific scientific purpose, we may safely conclude that they were the best that could be had'. The meteorological instruments as at April 1853 are included in Appendix 2 below.

[75] E. Walker, *Terrestrial and Cosmical Magnetism* (Cambridge, 1866).

[76] Kay (footnote 34).

[77] Francis Abbott, *Results of Meteorological Observations for Twenty Years for Hobart Town, Made at the Royal Observatory, Ross Bank, from January 1841, to December 1854, and at the Private Observatory, from January 1855 to December 1860, Inclusive* (Hobart Town, 1861).

The Rossbank results were incorporated in Abbott's subsequent summaries of later meteorological observations for Hobart Town published in 1866, 1872, and 1877.[78] It is interesting to note that Abbott, who had been transported from England to Van Diemen's Land in 1845 'for obtaining two watches under false pretences', later became a well-known clockmaker in Tasmania and eventually one of the leading astronomers of Australia, and a Fellow of the Royal Astronomical Society of London.[79]

## Appendix 1

### Records of the Rossbank Observatory Hobart, 1840–54, in the Archives Office of Tasmania

List copied from the accessions file in the Archives Office
(Approximate footage on the shelf is given in centimetres)

(1) Registers of term day observations of magnetometers, barometers, thermometers and inclinometers, 28 August 1840 to December 1849. (23 cm)
(2) Registers of various magnetic experiments, 21 September 1840 to 3 May 1851. (8 cm)
(3) Register of miscellaneous observations and calculations, 21 September 1840 to 28 December 1854. (4 cm)
(4) Graphs based on declination magnetometer observations 19 October 1840 to September 1843. (4 cm)
(5) Extracts from letters to Lieutenant Joseph Henry Kay, R.N., from H. Lloyd, C. B. Riddell, Colonel Sabine and C. W. Younghusband on instruments used at the observatory, and miscellaneous instructions on the use of instruments, 5 May 1841 to 17 February 1847. (1·25 cm)
(6) Register of experiments with various instruments, 1 April 1853 to *c.* December 1854 (Part of 5 above).
(7) Register of observations of various experiments made with a portable inclinometer, 5 November 1844 to 15 January 1855. (4 cm)
(8) Registers of experiments in magnetic vibration, 7 December 1844 to 30 March 1853. (9 cm)
(9) Registers of experiments in magnetic deflection, 7 December 1844 to 21 Feb. 1849; 20 Aug. 1851 to 28 December 1854; 30 November 1850 to 17 July 1852. (14 cm)
(10) Registers of disturbance observations using a bifilar magnetometer, January 1845 to September 1851. (4 cm)
(11) "Experiments made for ascertaining the temperature co-efficient of all the magnets in the small and portable instruments", 25 March 1845 to December 1854. (1·25 cm)
(12) Register of observations made with an actinometer, 23 July 1845 to 7 June 1847. (4 cm)

[78] Francis Abbott, *Results of Twenty-five Years' Meteorological Observations for Hobart Town, Together With a Two Years' Register of the Principal Atmospheric Meteors and Aurora Australis* . . . (Hobart Town, 1866); and Francis Abbott, *Results of Five Years' Meteorological Observations for Hobart Town; With Which are Incorporated the Results of Twenty-five Years Observations Previously Published by the Royal Society of Tasmania, and Completing a Period of Thirty Years* (Hobart Town, 1872); and Francis Abbott, *Results of Five Years' Meteorological Observations for Hobart Town; With Which are Incorporated the Results of Thirty years' Observations Previously Published by the Royal Society of Tasmania and Completing a Period of Thirty-five Years* (1841–75) . . . (Hobart Town, 1877).

[79] *Australian Dictionary of Biography (1851–1890)* (Melbourne University Press, 1969), III.

(13) Registers of magnetic dip observations, 2 June to 23 June 1849; 14 February 1851 to 27 January 1852; 21 January 1853 to 26 December 1854. (6·25 cm)
(14) Monthly summaries of magnetic dip observations, 30 December 1845 to December 1852. (1·25 cm)

## Appendix 2
## List of Instruments etc., April 1853.

Transcribed from a record in the Archives Office of Tasmania
(CSO 24, Volume 223, No. 8403)

(A) *Those of the Colonial Government in charge of Mr Jeffery*
- (1) Achromatic telescope 42 in. focal length and $2\frac{3}{4}$ in. aperture.
- (2) Brass dip instrument.
- (3) Small Fox's dipping needle.
- (4) Reflecting circle by Troughton.

(B) *Those transferred by Kay to Sir William Denison*
- (1) Large declination magnetometer with 15 in. magnet, reading telescope, brass box and magnet, small scale—complete.
- (2) Large bifilar magnetometer with 15 in. magnet, reading telescope, weight, spare suspension wheels, spare scale, thermometers.
- (3) Vertical force magnetometer 12 in. magnet, thermometer and a box containing brass needle and scale for adjustment.
- (4) Small declination instrument with scale and reading telescope 3·65 in. cylindrical magnet and mirror complete.
- (5) Small bifilar instrument scale and reading telescope. Thermometer. 3 in. hollow cylindrical magnet and mirror.
- (6) Induction inclinometer with 2 soft iron cylinders, reading telescope and scale. 2 thermometers 3·65 in. with magnet and mirror complete.
- (7) Lloyd's unifilar for observations of deflection and vibration.
- (8) Spare small declination instrument.
- (9) Small declinometer with oak box for the collimator magnets, brass bar and plummet.
- (10) Spare unifilar instrument incomplete (theft of 1850).
- (11) Two spare 15 in. bar magnets.
- (12) Box bar magnets.
- (13) 9 in. dip circle by Robinson. Two needles and box of bar magnets.
- (14) 9 in. dip circle by Robinson. Two needles (1 broken) and box of bar magnets.
- (15) Seven cylindrical small magnets with mirrors.
- (16) Copper box with spare mirrors for small magnets.
- (17) Three sets of cylindrical weights and 2 copper rings for determining the moments of inertia of the small magnets.
- (18) Mahogany vibration box.
- (19) Cedar ditto.
- (20) Copper case for temperature experiments vertical force needle.
- (21) Copper trough for ditto.
- (22) Wooden ditto.
- (23) 3-day chronometers—819 Hewitt, 53 Cribb, 1512 Cathro.
- (24) 6in. theodolite by Jones.

(25) 12 in. transit theodolite by Troughton and Simms.
(26) Brass standard measuring scale.
(27) 5 tripod stands.
(28) Glass artificial horizon (level broken).
(29) Iron trough, bottle and roof of artificial horizon.
(30) Oslers anemometer and clock.
(31) Royal Society's standard barometer.
(32) Mountain barometer.
(33) Parabolic mirror for experiments of terrestrial radiation.
(34) 4 Actinometers.
(35) 4 lock-up presses containing the original registers of the Observatory 1840–53.
(36) Box of stationery.

*Thermometers*

(1) Standard mercurial thermometer by Ronketti.
(2) Wet and dry bulb thermometer by Newman.
(3) Long ivory scale spiral thermometer by Adie.
(4) 2 black bulb thermometers for solar radiation by Newman.
(5) 2 minimum self-register spirit thermometers by Newman.
(6) Maximum and minimum self-register mercurial thermometer by Jones.
(7) Maximum and minimum self-register mercurial thermometer by Pastorelli.
(8) Daniels hygrometer by Newman.
(9) Small thermometer by Jones.

Signed by Denison and Jeffery
April 1853

## Appendix 3

### Biographical Notes on the Officers of the Observatory

DAYMAN, JOSEPH (d. 1868)

Served as Mate and later Lieutenant on the staff of the Rossbank Observatory from 1840 to 1844. Son of the Reverend Charles Dayman, Rector of Great Tew, Oxfordshire. Entered the Navy 21 October 1831. Passed for Lieutenant 11 May 1838. Mate of H.M.S. *Erebus* (Captain James Clark Ross), 1839. In the preface to his narrative of the Antarctic voyage of 1839–43 (p. xlvii), Ross tells us that the drawings of Christmas Harbour, Nine Pin Rock, and deep sea soundings were by Dayman. Left ship for the Rossbank Observatory 1840. Lieutenant, 4 October 1843. Employed on a survey of the coast of Ireland in the *Tartarus*, steamer (Captain James Wolfe) 23 July 1845. In the *Rattlesnake* (Captain Owen Stanley) 1846–50, surveying off New Guinea and the Louisiade Archipelago. Stanley described him as "a very clever and intelligent person". In the *Maeander*, additional for surveying, (Captain Charles Talbot), 1 September 1852. Began the Cape of Good Hope Survey, 1853. In the *Cyclops* took soundings for the trans-Atlantic cable from Dingle Bay in Ireland to Newfoundland, 1857. The following year, he assisted at the abortive attempt to complete the cable laying with cable embarked in the British *Agamemnon* and American *Niagara*. In August 1858 he commanded the *Gorgon* in another attempt by the same vessels, during which a splice was made in mid-Atlantic, but the connection did not last more than a month. The

*Gorgon* made a series of deep soundings in September and October 1858. Dawson tells us that for his services in the *Gorgon*, as a colleague of Captain Otter, Dayman received a gold watch and parchment from the Mayor of New York. Captain of the *Firebrand*, May to November 1859, deep sounding during the summer in the Bay of Biscay and Mediterranean. In the *Hornet*, 4 May 1861, East Indies. Captain, 19 September 1863. Death in *Navy List* corrected to 20 December 1868.

Dayman wrote the following reports:

*Deep sea soundings in the North Atlantic Ocean between Ireland and Newfoundland made in HMS Cyclops, in June and July 1857*. (London, 1858).

*Deep sea soundings in the North Atlantic Ocean between Newfoundland, the Azores and England, made in HMS Gorgon, in September and October 1858*. (London, 1859).

*Deep sea soundings in the Bay of Biscay and Mediterranean Sea, made in HMS Firebrand, in the summer of 1859*. (London, 1860).

Sources: *Navy List*; O'Byrne's *Naval biographical dictionary* (1849); Sir Archibald Day, *The Admiralty Hydrographic Department* (1967); Dawson's *Memoirs of Hydrography*, Part 2, p. 69–70; Adelaide Lubbock, *Owen Stanley* (1968); Margaret Deacon, *Scientists and the sea* (1971).

JEFFERY, SAMUEL

Samuel Jeffery was one of the 'gentlemen volunteers' resident in Van Diemen's Land, who supplemented the regular staff of Rossbank as observers on Term Days between November 1840 and February 1842. He was appointed as salaried assistant at the Observatory in September 1842 by Sir John Franklin, with Admiralty approval. He continued as such until 1853, when on Kay's recall, he was made Superintendent in sole charge of the Observatory at the expense of the Colony. He became unemployed on the closure of Rossbank at the end of 1854. His petitions either for further employment by the Colonial Government or for an Admiralty pension were not granted. He pursued his claim to a Government post in a letter dated 9 June 1855 from Balmain, Sydney to the Colonial Secretary in Hobart and wrote again from Sydney a year later on 30 July 1856. In this letter Jeffery stressed that he had been led to believe his prospects would not be damaged by working at the Observatory and referred to the 'deep injustice' of being refused both further employment and a pension. (Archives Office of Tasmania CSD 1/53/1062. Transcript by Mrs Shirley Eldershaw.) The former Director wrote on Jeffery's behalf to the Colonial Secretary in Hobart on 28 August 1856, saying that he had already remonstrated with the Admiralty and that he considered it 'really shameful ... that a man should give up 13 of the best years of his life to the public service, and then be turned adrift like an old shoe'. Kay still hoped to coerce the Admiralty into awarding a small pension to Jeffery but 'in the meantime he is starving' (C.S.D. 1/95/2613. Transcript as above).

Jeffery must have survived this crisis however, since we next hear of him in the United Kingdom as Superintendent of the Kew Observatory. He was appointed to this post on the transfer of the Observatory from the British Association to the Royal Society in 1871. (Robert Henry Scott, 'The history of the Kew Observatory', *Proceedings of the Royal Society*, 39 (1885), 63. Dr. S. Malin kindly drew attention to this later phase of Jeffery's career.) He left in February 1876, no reason being given for his resignation. (*Proceedings of the Royal Society*, 25 (1876–77), 377; *Report of the Kew Committee*, year ending 31 October 1876, 377.) A staff photograph of the 1870s shows him as the central figure. (*Meteorological Magazine*, 91 (1962), 200–201.) So far no obituary nor other details of his career have come to light.

KAY, JOSEPH HENRY (1815–75) directed the Rossbank Observatory from 1840 to 1853. Second son of Joseph Kay (1775–1847), architect, and his wife Sarah Henrietta, *née* Porden, and through her a nephew of Sir John Franklin by the latter's first marriage.

Entered the Navy on 18 December 1827 and passed for Lieutenant on 6 April 1839. Served in H.M.S. *Terror* (Captain F. R. M. Crozier) on her outward passage to Van Diemen's Land. Left ship to direct the magnetic observatory.

Married Maria, fourth daughter of George Meredith, November 1845. He was elected a Fellow of the Royal Society on 26 February 1846 and was a founding member of the Royal Society of Tasmania. Appointed Commander 23 August 1849 and Retired Captain under order-in-Council 9 July 1864. After leaving Tasmania he held various posts in the public service of the State of Victoria, and at his death was Clerk to the Executive Council. Died from diabetes, 17 July 1875 at South Yarra, Melbourne. Buried St Kilda cemetery.

Sources: *Navy List. Australian Dictionary of Biography.*

Kay published the following papers:

'Terrestrial magnetism'. *Tasmanian Journal*, 1 (1842), 124–35. ("By Lieut. J. H. Kay, R.N., H.M.S. Terror, Magnetic Observatory, Hobart." Paper written at request of Sir John Franklin, Lieutenant-Governor of Van Diemen's Land, outlining history of subject from ancient times.)

'Description of the instruments employed in the Magnetical Observatory, Tasmania.' *Tasmanian Journal*, 1 (1842), 207–24. ("By Lieut. J. H. Kay, R.N., H.M.S. Terror, Director of the Observatory." Abridged descriptions of magnetic instruments from the reports of Professor Lloyd. "Besides these, the observatories are furnished with a complete set of the most refined meteorological instruments for accurate observation of the atmospheric changes ... a Transit Instrument for the correct determination of time, chronometers etc. etc.")

'Extracts from a daily journal of remarks and observations on the comet, as seen at Van Dieman's [*sic*] Land. *Monthly Notices of the Royal Astronomical Society*, 6 (1845), 5–7. ("By Lieut. Kay, R.N. Communicated by Lieut.-Colonel Sabine, R.A. Observed March 1843.)

'On solar radiation, with a description of the actinometer.' *Tasmanian Journal*, 2 (1846), 397–402. ("By Lieutenant J. H. Kay, R.N. Director of the Magnetical Observatory, Hobart." Contains example of observations and calculations giving intensity on 6 April 1844 in Van Diemen's Land.)

'On the aneroid barometer.' *Papers and Proceedings of the Royal Society of Van Diemen's Land*, 1 (1849–50 (pub. 1851), 83–87. ("By Lieut. Kay, R.N., F.R.S., Director of the Royal Observatory, Hobart Town." Principles upon which "this elegant little philosophical instrument of very modern invention" was constructed; tests of its powers on Mount Wellington; comparison with mercurial barometer at the Royal Observatory, Hobart Town.)

'Meteorological tables for the years 1847 and 1848; made at the Royal Observatory, Hobart Town, lat. 42°52′S., long. 9h.50m.E.' *Papers and Proceedings of the Royal Society of Van Diemen's Land*, 1 (1849–50 (pub. 1851), 144–53. ("By Lieut. Kay, R.N., F.R.S., Director of the Observatory".)

'Meteorological tables for the year 1849; Royal Observatory, Hobart Town ...' *Papers and Proceedings of the Royal Society of Van Diemen's Land*, 1 (1849–50, (pub. 1851), 255–57. ("By J. H. Kay, Esq., F.R.S., Commander R.N., Director of the Observatory", lat. 42°52′S., long. 9h.50m.E.)

'Observations made for determining the geographical position of the Magnetic Observatory at Hobart Town, Van Diemen's Land.' *Report, Papers and Proceedings of the Royal Society of Van Diemen's Land*, (1852–54), 264–87. ("By Commander Kay, R.N., F.R.S., etc." in connexion with the Trigonometrical Survey "now in course of operation in this Island". Various methods of observation and results obtained. The preferred longitude is given as 147°22′06″ east of Greenwich. The results of lunar observations made with a Dollond sextant of eight inches radius were being calculated by the first class boys of the Nautical School at Greenwich under "Mr Riddle, the Head Mathematical Master". Latitude obtained with the same sextant gives 42°52′13.7″ South. More rigorous results may be obtained in the ensuing winter from the use of the Troughton altitude and azimuth instrument used in field operations in the trigonometrical survey.)

'Meteorological tables, Royal Observatory, Hobart Town.' *Report, Papers and Proceedings of the Royal Society of Van Diemen's Land*, (1852–54), 292–307. ("By Commander Kay, R. N., F.R.S., for years 1850–52, with means for 1841 to 1848. Refers to the publication by the British Government of two volumes "of the magnetical and meteorological observations made at Hobart Town under my direction" mainly devoted to investigation of horary, diurnal and annual variations of the magnetic elements, with their peculiar changes. This great object having been attained, "the connection of the British Government with the Observatory in Tasmania will cease in April 1853". The third volume of the Hobart Town observations "will discuss the peculiarities of the climate of Hobart Town, as exhibited in the extensive series of meteorological observations which have been made.")

SCOTT, PETER ASTLE (*d.* 1900)

Served as Mate on the Observatory staff 1840 to 1844. Entered the Navy 14 February 1829. Passed for Lieutenant 1835. Mate in the *Terror* (Captain F. R. M. Crozier) 1839 during her outward voyage to Van Diemen's Land. Left ship to serve in Rossbank Observatory 1840. Promoted Lieutenant 4 October 1843. From 24 July 1845 until her paying-off in early 1848, he served on the coast of North America in the *Columbia*, steam surveying vessel under Captain William Fitzwilliam Owen and Commander Peter Frederick Shortland. He was again in the *Columbia* under Shortland, 3 April 1849 until 1853. He joined the *Indus* (Captain John C. D. Hay) 5 October 1857 (for surveying service) and the *Nile* (Captain Edward K. Barnard) also for surveying service, 9 January 1862. He was promoted Captain 4 September 1866. His death appears in the *Navy List* corrected to 18 June 1900, (deaths reported since 18 March 1900).

Sources: *Navy List*. O'Byrne's *Naval biographical dictionary* (1849).

SIMPKINSON, FRANCIS GUILLEMARD (1819–1906)
later Simpkinson de Wesselow

Served at the Rossbank Observatory 1844 to 1849.

Born 26 May 1819 in London, son of Sir J. A. F. Simpkinson, barrister, and his wife Mary (née Griffin) a sister of Lady Franklin. Joined the Navy as a first class volunteer in H.M.S. *Britannia*, 120 (Captain Peter Rainier) under whom he spent three years on the Lisbon and Mediterranean stations. He joined the *Jupiter*, 38 (Captain E. H. A. Court) early in 1835 and later the same year the *Samarang* (Captain William Broughton). In

the surveying vessel *Sulphur* (Captains F. W. Beechey and Edward Belcher), he helped as a midshipman to make pendulum observations during the first cruise (1835 to 1838) of a round-the-world voyage. Transferred to the *Harrier* (Captain W. H. H. Carew) in June 1838, he passed for Mate 17 September 1838 in the *Excellent*, gunnery ship at Portsmouth (Captain Thomas Hastings) and then spent a year at the Royal Naval College there. In 1840 he served in the *Rainbow* (Captain Sir John Franklin). In August 1841 he joined the *Warspite*, 50 (Captain Lord John Hay) and in September that year the *Cambrian*, 36 (Captain H. D. Chads) as gunnery mate, assisting in the defence of the island of Chusan. He returned from China to England to serve in the *Excellent* (Captain Sir Thomas Hastings) and the *Albion* (Captain Nicholas Lockyer) on home service. In September 1844 he joined the staff of the Rossbank Observatory in Van Diemen's Land, being promoted to Lieutenant in December 1848. He painted a number of landscapes, many of which remain in Tasmania, including the watercolour of the Observatory reproduced here. He left Hobart in 1849 for England and served last in the *Fisgard* (Captain Shepherd) on surveying duties, March 1854 to March 1855.

In 1869, he added 'de Wesselow' to his surname by deed poll and latterly lived in Cannes. He died in London on 4 December 1906, leaving a large estate. Mr. Max Angus, the Tasmanian artist, is at present (1981) preparing a publication on the watercolours of Simpkinson de Wesselow.

Sources: *Navy List*. O'Byrne's *Naval Biographical Dictionary* (1849). *Australian Dictionary of Biography*. Sir Edward Belcher, *Narrative of a voyage round the world* (London, 1843). Richard A. Pierce and John H. Winslow, eds. *H.M.S. Sulphur on the Northwest and California coasts, 1837 and 1839: the accounts of Captain Edward Belcher and Midshipman Francis Guillemard Simpkinson*. (Kingston, Ontario, Limestone Press, 1979).

SMITH, ALEXANDER JOHN (*d*. 1872)

Served as Lieutenant on the staff of the Observatory, 1844 to *c*. 1851. Entered the Navy, 18 December 1826, as a first class volunteer on board the *Thetis* frigate (Captain Sir John Philimore), for South America, which was wrecked off Cape Frio on 5 December 1830. Returned to England in the *Druid*, 46, (Captain Gawen William Hamilton). Discharged the ensuing March. In January 1832 joined the *Harrier* (Captain S. L.H. Vassall) as midshipman for the East Indies, engaged in the suppression of piracy in the Straits of Malacca and took part in two severe conflicts. Passed Lieutenant's exam, 5 August 1835. Joined the *Cove*, 6th rate (Captain James Clark Ross) as Mate, departing from England, January 1836 to seek missing whalers beset in Baffin Bay. Served for a few months on the north coast of Spain in the *Salamander*, steamer (Captain Sidney Colpoys Dacres). Spent two years as extra Mate in the *Mastiff*, surveying vessel (Master, Commander George Thomas) among the Orkney Islands. In April 1839 he was again under Ross's orders as Senior Mate on board the *Erebus*, during the Antarctic expedition. Promoted Lieutenant 16 August 1841. Came home September 1843. Arrived in Hobart 1844 to relieve Lieutenants Scott and Dayman. Wrote to *Hobart Town Advertiser*, 28 November 1848 about whaling possibilities in the Antarctic. Believed to have left the Observatory, 1851. Promoted Retired Commander 1864. Death appears in *Navy List* corrected to 20 December 1872 (deaths reported since 20 September 1872). C. R. Markham's *Arctic Navy List* (1875) says that he died a Retired Commander in Melbourne, 1873.

Sources: *Navy List*. O'Byrne's *Naval biographical dictionary* (1849).

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