

# 'Extraneous government business': the Astronomer Royal as government scientist: George Airy and his work on the commissions of state and other bodies, 1838-1880

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## **Abstract**

In the absence of a scientific civil service the governments of Victoria's reign had few public servants to consult when it came to the requirement for specialist scientific and technological advice – and this was at the height of the industrial revolution when the enormous changes wrought were affecting the whole population of Britain. So governments turned to one man of cast-iron probity and unparalleled credentials: George Airy. Though his formal scientific training was in mathematics and astronomy, not the engineering and thermodynamics that the industrial age might have called for, Airy gave of his time and energy to the full. But what were the purposes of the commissions? When did they sit? Who ran the Royal Observatory in Airy's absence? Only recently have the original papers in the RGO Archives been plumbed in any depth and the answers to these questions make an intriguing story.

**Keywords:** *Astronomer Royal, commissions of state, government science, Royal Observatory.*

## **1 INTRODUCTION: HISTORY AND BIOGRAPHY**

The first result of research is the discovery that there is much more to the subject than the researcher had anticipated. Even given a background of 19 years familiarity with Airy and all his works, this was certainly the case with the present author and this paper. Close professional association with the Royal Observatory records means that few days pass without reference to George Airy's papers in Cambridge University Library. However, it was the research into the subject of this paper that amply demonstrated just what Airy had achieved in this sphere.

When the Royal Greenwich Observatory [RGO] was about to close at Herstmonceux and move to Cambridge in 1990, Sir William McCrea gave the last lecture to the joint RGO/Sussex University astronomical society that he had helped to found soon after the establishment of the astronomy institute at Sussex. He commented light-heartedly, though addressing a plain truth, "Sir George Airy single-handedly undertook duties fulfilling which today collectively occupies the resources of several entire research councils".

History is a continuous cloth; to look at the biography of one person is to take a small fragment of a different sort of material and hold it against the cloth from the broad loom. One must question how much holding the fragment against the seamless fabric tells you about the whole broad pattern around your patch of cloth; how well the patterns of the cloths match indicates how well the person fits into the character of his age. In some cases only a complete mismatch is achieved, of someone who clashes with the spirit and culture of their time. In the case of the seventh Astronomer Royal, George Biddell Airy, you find that the biographical fragment melds effortlessly into the broader pattern of his period.

No doubt it is a cliché to say that the nineteenth century was a period of unprecedented social, political, and technological change. Nevertheless this is the case. The end of the wars with France in 1815 ended the post-medieval modern era for Britain. The religious divisions of the sixteenth and seventeenth centuries were behind the country and no longer governed matters of state. These matters were taken as settled. The stirrings of the industrial revolution were already manifest with the primitive use of steam-power in the mines, the laying of tracked roadways for mine wagons, the smelting of metal by coal-fired furnaces, and the introduction of

spinning and weaving machinery were harbingers of a new age. Erasmus Darwin and the luminaries of the Lunar Society were the fresh minds of this new age in what would in a few decades become the heart of industrial Britain.

George Airy, born shortly before Erasmus Darwin died, grew up in the years of the Napoleonic War; he was fourteen when the Battle of Waterloo settled European affairs of state for a century. In Britain the peace led to social upheaval with the demobilization of the army and navy and the movement for the emancipation of the working man which was a background to Airy's Cambridge years. The 'Peterloo' massacre on St. Peter's Fields in Manchester at a meeting to promote the extension of the franchise occurred in 1819, the year that Airy went up to Cambridge. The foiling of the 'Cato Street' conspiracy took place in the following February.

Airy's family was not a wealthy one, his father being an excise collection officer. It was through George's uncle Arthur Biddell that George met Thomas Clarkson, the anti-slavery associate of William Wilberforce, who in turn introduced the very gifted young Airy to a fellow of Trinity College. Airy tells the story in his *Autobiography*,<sup>1</sup> a work described by an assistant from Airy's later period of office, Walter Maunder, as "... to anyone not personally acquainted with Airy ... heavy and monotonous".<sup>2</sup> This is a moot point and some disagree with Maunder, who was perhaps too personally close to his subject as he had been an assistant under Airy for eight years before the Astronomer Royal retired. Though indeed the *Autobiography* tells little of Airy as a person, it is an invaluable source that relates the activities of a remarkable career, as the endnotes to this paper amply demonstrate.

Thus Airy became a Cambridge mathematician and as a consequence of his studies, his profession became astronomy. In his university career he progressed from the Lucasian chair in mathematics, once held by Isaac Newton, to the Plumian chair in astronomy. Airy applied his mathematics to the sciences, was appointed Astronomer Royal, reformed every facet of the Royal Observatory to such an extent that his direct influence was remembered by staff still in post when the RGO was closed in 1998. Airy became something of an engineer in the design and construction of the Greenwich telescopes of his tenure and improved the regulators of the Royal Observatory. He was the astronomer *par excellence* of his day.

However this paper is not, by its very title, about Airy the astronomer but Airy the professional government scientist as he served the governments of his country. That Airy did not take the view his duties should include the 'nitty-gritty' work of nightly observation and daily reduction is well recognized. Allan Chapman has drawn our attention to Airy's attitude to his work and duty<sup>3</sup> and shows clearly that central to Airy's perception was the royal warrant of appointment to his office:

Victoria, by the Grace of God of the United Kingdom of Great Britain and Ireland, Queen, Defender of the Faith. To our trusty and well beloved George Biddell Airy Professor of Astronomy in the University of Cambridge. We, being well satisfied of your learning and your industry and great skill and ability in the science of astronomy by these Presents constitute and appoint you Our Astronomical Observatory at Greenwich during our pleasure; requiring you forthwith to apply yourself with the most exact care and diligence to the rectifying the Tables of the motions of the heavens and the place of the fixed stars in order to find out the much desired Longitude at sea for perfecting the Art of Navigation ...<sup>4</sup>

For all but two years, Airy was Astronomer Royal under Queen Victoria. Victoria issued the last formal Royal Warrant for any Astronomer Royal; William Christie and his successors were offered the post of Astronomer Royal by the Admiralty without a warrant from the sovereign<sup>5</sup>. Airy had first been offered, and had provisionally accepted, the post of Astronomer Royal in 1834. A change of government had put the offer into abeyance but when the administration of Robert Peel took office the offer was once more made and then accepted by Airy<sup>6</sup>.

Walter Maunder, the contemporary observer of Airy's *modus operandi* was not at all an uncritical observer. He assessed Airy's character in the following terms "It is most difficult to give any adequate impression of his far-reaching ability and measureless activity. Perhaps the best idea of these qualities may be obtained from a study of his autobiography ..." though Maunder goes on to call that volume, as already, noted "heavy and monotonous"<sup>7</sup>. It is worth quoting in the context of the Royal Observatory records some more of Maunder's remarks about Airy himself; "... great as Airy was, he had the defects of his qualities ... His love of method and order was often carried to an absurd extreme, and ... one of the greatest intellects of the

century was often devoted to doing what a boy at fifteen shillings a week could have done as well, or better" and reports Wilfrid Airy's comment "in his last days he seemed to be more anxious to put letters ... into their proper place ... than even to master their contents"<sup>8</sup>.

Wilfrid Airy also tells us of his father "In all his views and opinions he was strongly liberal ...", Wilfrid going on to cite two instances of Airy's opposition to religious bigotry in the University of Cambridge, and proceeds "... he was opposed to every kind of narrowness and exclusiveness ... But all his views were in the liberal direction ..."<sup>9</sup> which assessment might be compared to the comment by Maunder on Airy's personal administration of Greenwich Observatory in the words "his regulation of his subordinates was ... despotic in the extreme – despotic to an extent which would scarcely be tolerated in the present day ..." concluding that "A regime so personal ... was almost avowedly intended to militate against the growth of real zeal and intelligence in the staff ..."<sup>10</sup>

The assessment of Airy as "...one of the greatest intellects of the century ..." would bear some examination but in the context of Maunder's world is no doubt adequate. Maunder only briefly refers to the commissions of state and similar activities in his observations about Airy's work; he was an astronomer and Airy, by virtue of his position and abilities, one of the great astronomers of his age. But Maunder summarizes the extraneous work "... he was confidential adviser of the Government in a vast number of subjects: lighthouses, railways, standard weights and measures, drainage, bridges – he yet always kept the original objects of the Observatory in the very first place"<sup>11</sup> and makes another telling remark: "Airy had ... the true spirit of the public servant; his sense of duty to the State was very high. He was always ready to undertake any duty which he felt to be of public usefulness, and many of these he discharged without fee or reward".<sup>12</sup>

The royal warrant was all-important to Airy. The wording had barely changed since Charles II addressed his well-beloved John Flamsteed. To Airy the meaning was plain; he was to do what the governments of his day wanted him to do; it was a new interpretation of the warrant, but not by that token incorrect. Clearly, however, Flamsteed, Halley, Bradley, Bliss, Maskelyne, and Pond had not taken quite this view, or had assumed that the direction of the warrant was the literal interpretation, to undertake astronomical observations and reductions and the publication of tables of results, all for the betterment of navigation. Airy directed that this was the purpose of the foundation at Greenwich but did not apply that direction to his personal duties.

Flamsteed was perfectly clear about the meaning of the warrants of Charles II and Anne, the celebrated quarrel with Newton and Halley springing partly from that interpretation. Halley perhaps came to sympathize with Flamsteed's view when he took over at Greenwich and clearly Bradley and Bliss understood their duties in this way. Perhaps with Nevil Maskelyne we begin to see the work at Greenwich rather less as though it was prosecuted on an astronomical island. Much of Maskelyne's work he undertook in his *ex officio* role on the Board of Longitude, a body which had existed since Flamsteed's time but which Maskelyne found very important to his Greenwich operations. That work was still as specified literally in the warrants, however.

Working with inadequate funding and few staff all of whom do more than one job is not a new phenomenon. The story of the Astronomers Royal over the centuries is a case in point. Vital to the history of the development of the work at Greenwich in the nineteenth century is the trend begun by Pond and extended by Airy to increase the number of staff working at the Royal Observatory. Until Pond's time, Greenwich operated with the Astronomer Royal and his assistant, as laid down by another warrant of Charles II in 1675. If Maskelyne was away at a Board meeting, there was just one astronomer left at Greenwich. If Pond increased the staff working under him, he quite clearly remained of the opinion that his place was at Greenwich, however irksome he came to find the work.

The Board of Longitude remained in being until 1828 and as Plumian Professor at Cambridge, George Airy sat on the Board. Pond's relationship with the Board was different to Maskelyne's though the Board remained of great importance to the work at Greenwich until its dissolution. Airy observed the Astronomer Royal's relationship to the Board of Longitude but more importantly observed Pond's dealings with the Board of Visitors to the Royal Observatory, and these observations led to the way Airy, after his acceptance of the post of Astronomer Royal, approached his directorship.

While the Astronomers Royal before Pond were working in the pre-industrial age, at a pre-industrial pace, the social changes of the early part of the nineteenth century were responsible in part for the pressures that mounted on Pond. These tended to bear him down; there was the production of the almanac, the routine work on chronometers and the difficulties with his assistants, problems with administration and staff that are familiar enough to us today. There are distant echoes of the way there is now between research establishments and the universities the tension created by competition for funding, staff and projects and by fine professionals gradually diverting their energies away from their professional expertise into the administration of their establishments.

There are horses for courses. Pond's course was essentially laid down by Maskelyne and his predecessors but the tenor and requirements of his time meant that Pond began to alter the *modus operandi* of the Greenwich Observatory. Airy took up where Pond left off and forged a completely new course for Greenwich in the modern Victorian era, though Airy for one was always quite clear on how much the Royal Observatory owed John Pond.

Airy started as he meant to go on. Where Pond had been dragged down by the weight of care Airy, a younger, more dynamic and more forceful personality, was dealing from a position of strength. The government of the day positively wanted him in the post and his bargaining position was thus enhanced. Airy thrived on the modern way of proceeding. From this starting point, Airy made his own interpretation of the terms of the warrant; his duty was to direct his minions, to whom Pond famously referred as "drudges", to achieve this aim. The Astronomer Royal was above, or at any rate aside, from the daily astronomical work at Greenwich. So Airy took to be the direction of his sovereign Queen Victoria. James South wrote in a letter to the Admiralty in 1847 that of the 69,204 observations made at Greenwich between 1836 and 1844, only 164 had been made by Airy himself.<sup>13</sup> Which was just how Airy intended it should be.

This hardly left Airy at a loose end. He was a man of enormous industry, industry attested by only a casual inspection of the manuscripts stacks in Cambridge. A century and a half of the Royal Observatory's history, the papers of the Astronomers Royal from Flamsteed to Pond, occupies some 30 metres of shelving. Then Airy's papers begin and do not end for another 110 metres of shelving. The papers are contained in eight hundred and thirty-five substantial volumes of correspondence and papers associated with all aspects of the work at Greenwich and the work of George Airy. This includes copies of the complete outgoing as well as incoming correspondence and copies of all Airy's own work. To quote from the *Autobiography* "... having seen the utility of the Copying Press in merchants' offices, I procured one. From this time my correspondence, public and private, is exceedingly perfect",<sup>14</sup> though the perfection of the correspondence and papers arises directly from Airy's method rather than the copying press. It has been said that Airy was "methodical beyond belief".<sup>15</sup>

The offer of knighthood was made to Airy on several occasions before his accepting the honour in 1863; Airy had been offered this first on 1835 December 08, only a few months from taking over the Greenwich directorship and in his letter declining the offer written a couple of days later he made a telling remark in conclusion "I have only to add that my services will always be at the command of the Government in any scientific subject in which I can be of the smallest use".<sup>16</sup>

The new cataloguing of the papers at Herstmonceux undertaken in the 1980s naturally followed the archival 'best practice' of maintaining the contemporary arrangement of the original records. It needs little reflection to realize that to have tried to alter in some way Airy's arrangement of his Greenwich records would have been folly indeed; Airy was following 'best practice' one hundred and fifty years before the Herstmonceux archivists followed and put that same practice into operation. Airy's own arrangement of his records was maintained and few new readers of the papers fail to be amazed by the sheer size of the catalogue, let alone the actual collection.

This readiness on Airy's part to serve the government leads on to his involvement with the commissions of state. The appointment of commissioners arose out of the needs of governments in a more modern age and it was the time to be someone considered one of 'the great and good'. Airy was available as a government-employed scientist, yes; and social and technological history converged to make him the right man at the right time, a Cambridge

educated academic as well as the Astronomer Royal, a practical man with knowledge of engineering. The needs for guidance in the fields of science and engineering by the governments of the industrial age were many.

The commissions had begun their history in the early years of the century and had advised governments on such subjects as working and living conditions in the new cities, sanitation and emancipation; they have since become a pillar of the prosecution of government in this country, as the complexity of society, science, and technology, and the cultural environment have increased.

Another of Allan Chapman's papers<sup>17</sup> illustrates much of this background. There was no scientific civil service, no research councils, no Department of Scientific and Industrial Research. From 1820 it had been the Admiralty who controlled the Royal Observatory, which was funded through the annual navy votes. The 'interface' between Airy's Greenwich and his government masters was the Hydrographer's Office. To this day, the Public Record Office in its institutional history of the RO and its offspring the Royal Greenwich Observatory takes the view that the Observatory was a department under the Hydrographic Office, until the RGO was transferred to the auspices of the new Science Research Council in 1965. Thereby hang other tales. Greenwich was unique in the Britain of the nineteenth century, and indeed of the seventeenth and eighteenth centuries, though they do not concern the subject of this paper, in being a government funded scientific establishment. It was not a research establishment, at least in Airy's time, but Airy was the senior 'scientific' civil servant – and his assistants were the only others of the day.

Airy filed away the warrants of George IV and Victoria in their proper places in the early portion of the seven volumes, about two feet of shelf-space, which Airy classified as *Government superintendence*, essentially how he dealt with his masters at the Admiralty and how the Admiralty dealt with the Royal Observatory. Seven, even hefty, volumes are not such a great deal for 46 years of 'superintendence' – six or seven years per volume. The Admiralty was hardly breathing down Airy's neck, issuing continual orders to the Observatory and Astronomer Royal. What the Admiralty wanted was someone who would get on with the job without requiring too much superintendence.

Perhaps it would be more apt to say 'jobs'. The "extraneous government business" and the subjects covered by this paper Airy classified under other titles:

Volume titles	Range of dates	Classmarks
<i>Railway Gauge Commission</i>	1845-1848	MSS.RGO.6/284-321
<i>Metropolitan Commission of Sewers</i>	1846-1849	MSS.RGO.6/322-324
<i>Ordnance Survey Commission</i>	1858	MS.RGO.6/325
<i>Lighthouse Commission</i>	1860-1861	MS.RGO.6/326
<i>Sale of Gas Act</i>	1858-1863	MSS.RGO.6/327-334
<i>University of Melbourne</i>	1854-1856	MSS.RGO.6/335-336
<i>University of Sydney</i>	1851-1852	MS.RGO.6/337
<i>Standards Commission</i>	1838-1857	MSS.RGO.6/338-367
<i>Great Exhibition of 1851</i>	1850-1852	MS.RGO.6/441
<i>Paris Exhibition</i>	1854-1857	MS.RGO.6/442
<b><i>Extraneous government business</i></b>	1854-1880	MSS.RGO.6/443-445
<i>International Coinage Commission</i>	1852-1868	MS.RGO.6/446
<i>Gold Standard Table - Bank of England</i>	1870	MS.RGO.6/447
<i>Railways</i>	1840-1848	MS.RGO.6/448
<i>Steam engine propellers, ship building</i>	1838-1848	MS.RGO.6/449
<i>Sawmills for ship's timbers</i>	1842-1849	MS.RGO.6/450
<i>Atlantic submarine cable</i>	1858	MS.RGO.6/455
<i>Greenwich charities/Blue Coats School</i>	1839-1878	MSS.RGO.6/492-498
<i>Tidal harbour commission</i>	1839-1842	MSS.RGO.6/499-518
<i>Navigation on the River Dee</i>	1849-1853	MSS.RGO.6/519-522
<i>Construction of the Westminster Clock</i>	1845-1861	MS.RGO.6/607-609
<i>Compass correction in iron ships</i>	1838-1875	MSS.RGO.6/682-692
<i>Meteorological commission</i>	1875-1878	MS.RGO.6/704

This adds up to 212 pieces, whilst the total in whole Airy class is 835 pieces, indicating that this business occupies papers equivalent to about 25% of the Royal Observatory record over his tenure in office, 1835-1881.

In the words of Sir William McCrea "Airy became the national oracle on all technological matters".<sup>18</sup> Allan Chapman has estimated that Airy served upon or gave advice to at least three dozen commissions and government inquiries of a non-astronomical character during his 46 years as Astronomer Royal.<sup>19</sup> To pursue the theme of how the 'percentage of effort expended' by Airy has been regarded previously, it should be noted that in his short account of the Royal Observatory, McCrea (a celebrated and gifted astrophysicist) devotes nine pages to Airy's tenure of office and only a few lines to his work on the commissions, other bodies and the extraneous work. Professor Jack Meadows<sup>20</sup> hardly mentions the work and a later Astronomer Royal, Sir Harold Spencer Jones<sup>21</sup> only briefly refers to all this effort, which demonstrates how Airy's work on behalf of his country, but away from Greenwich, has not always been fully recognized.

There are several matters to note from this list with its huge range of activities. There is the span of dates, almost from Airy's appointment until his retirement, at least forty years of continual effort in fields that were not directly connected with, or were quite unconnected with, the astronomy done at Greenwich. Consequently this miscellaneous collection of subjects made a miscellaneous set of demands on Airy's time and ability.

Airy's concerns in his first years of office were however directly related to Greenwich and the associated work. He established the observing procedures he required, provided for the regular and retrospective reductions to be tackled, and looked to the printing of Groombridge's catalogue. There was the matter of the testing of chronometers and agreement with the Admiralty on the priority of the work as well as the new magnetic and meteorological observatory. In addition, the manuscripts had to be put in order and a place made for them while in Cambridge there was the University Observatory and the work on completion of the Northumberland Telescope which Airy wanted to oversee, as well as the work of the observatory at the Cape of Good Hope. All these required his attention and this work occupied the first years of his tenure to 1838.

Perhaps by this date the writing was on the wall. In fact it was an enquiry from Thomas Maclear at the Cape Observatory to the Admiralty that was the connecting thread from astronomy, to geodesy, to the standards commission. Captain Francis Beaufort of the Hydrographic Office passed to Airy Maclear's request for a standard of length to be used in the trigonometric survey of southern Africa. Airy wrote to Charles Wood, the Secretary to the Admiralty on 1838 March 13 pointing out that the national standard of length was wanting.<sup>22</sup> The answer brought Airy closer to an appointment as a commissioner.

With Airy working so much away from the Observatory on government work, selection is necessary in such a brief study as this. Only some aspects can be considered. The remainder of this paper will examine the following; (a) the work; (b) the records; and (c) the conclusions of two important commissions, first the standards of weights and measures commission and second the railway gauge commission. Reference will also be made to some of the other commissions of lesser importance, though Airy gave his fullest attention to the detail of every study he carried out for the governments of the day.

## 2 THE STANDARDS COMMISSION

With the exchange of correspondence over Maclear's enquiry, the wedge had its thin end inserted into Airy's work of astronomical superintendence in 1838. On May 11<sup>23</sup> Mr Spring Rice<sup>24</sup> wrote to Airy to ask him to be the chairman of the committee being established to report on what should be done to restore the national standards of weights and measures, which had been destroyed in the fire at the Houses of Parliament on 1834 October 16. Airy received the letter the next day<sup>25</sup> accepted and, in the manner of the times, did not let the matter hang on his hands. Just ten days later the commission of Airy as chairman, Francis Baily, J E Drinkwater Bethune, Davies Gilbert, J G S Lefevre, J W Lubbock, G Peacock and Richard Sheepshanks<sup>26</sup> had their first meeting.

A significant source of information on the extent of Airy's work extraneous to the functions of the Observatory are the four *Astronomer Royal's Journals* which Airy kept, covering the years 1836-1881, his complete period in office.<sup>27</sup> It is salutary to quote from the

*Journal* for the day of this first meeting as it is so characteristically Airy speaking: "May 22 Tuesday Rain in the morning, fine in the evening, wind W. A meeting of the Standards Commission was held at the Observatory".<sup>28</sup>

The commission began a prodigious amount of work, mainly meeting at the Royal Astronomical Society, with Airy not only Chairman but "as working secretary".<sup>29</sup> The recommendations of the commission were enacted on 1855 July 30<sup>30</sup> but Airy's related work went off and on for thirty-eight years in all, until 1876, and the international commission on the metre.<sup>31</sup>

The records consist of the official correspondence and minutes of the commission,<sup>32</sup> correspondence with commission members,<sup>33</sup> correspondence on the 'decimalization' of weights and measures,<sup>34</sup> general correspondence on standards,<sup>35</sup> acts of parliament,<sup>36</sup> the papers of Airy, Francis Baily, Richard Sheepshanks, and others on comparisons of length,<sup>37</sup> formal printed accounts of the work,<sup>38</sup> work on decimal coinage<sup>39</sup>, thermometer experiments<sup>40</sup> and further official and semi-official correspondence.<sup>41</sup> Airy gives a full account of the work in the *Philosophical Transactions* for 1857.<sup>42</sup> It was Airy's involvement with the standards and particularly that work recorded on decimal coinage that lead William Gladstone to ask for his advice to the Coinage Commission in 1853,<sup>43</sup> an example of how the cycle of Airy's involvement in giving governments advice was perpetuated.

It is worth noting that after discussions early in 1838, by July Airy had at the instance of Beaufort, the Hydrographer, begun his intensive series of experiments and calculations on the effects of iron hulls on ships' compasses using the iron built steamer *Rainbow*<sup>44</sup> owned by the General Steam Navigation Company. Again the work involved was rigorously conducted, vigorously prosecuted and protracted, taking place at much the same time as the standards work between 1838 and 1855.<sup>45</sup>

In his obituary of Airy,<sup>46</sup> H H Turner notes that the work of the commission "... included the preparation and comparison of a large number of copies of the standards for distribution to public bodies in England and to foreign Governments, thus securing the legal standards against future loss from any possible accident to the national standards".<sup>47</sup> A second standards commission under Airy's chairmanship was appointed in 1843 and it must be noted that much of the practical work on the actual determinations and the production of copies was the work of W H Miller, who worked on the standard of weight, and Francis Baily who was engaged on the length standard. Sir John Herschel relates that Baily had copied the standard yard by John Bird of 1758 onto a five feet scale for the Royal Astronomical Society six months before the disastrous fire of 1834<sup>48</sup> and before his death in 1844 Baily had expended much effort in recreating the standard. Richard Sheepshanks took over the work that Baily had commenced and made nearly ninety thousand measurements in the basement of the Royal Astronomical Society at Somerset House in perfecting the standard before 1855.<sup>49</sup>

Much was happening in England, Europe, and the wider world and it is suitable at this point to recall once more the historical context of Airy's work. That it was a time of great technological change, the age of the 'Industrial Revolution', can be seen plainly from the list of titles of the commissions. That Spring Rice first communicated with Airy about the Standards commission is significant enough, though given the role of the Astronomer Royal it was not unlikely that Airy would be at the least consulted on the subject of mensuration and standards. The tenor of the times really resounds in the subject matter of this paper with Airy's appointment to the royal commission on the railway gauge.

### 3 THE RAILWAY GAUGE COMMISSION

An interesting note is made by Airy in his journal for 1836 February 4; "Returned to Greenwich [from Cambridge]. In the evening wrote a report to the Admiralty upon the railroad".<sup>50</sup> The interest in this note stems from it demonstrating that Airy was considering the subject and using his official position to communicate on the subject of the railways, or at least the roadways themselves, only a few months after taking office and nearly ten years before the gauge commission was convened. At this date, Airy was plainly thinking about the effect that the vibrations from the trains passing over the railroads proposed for the environs of Greenwich Park would have on the Royal Observatory instruments,<sup>51</sup> but nonetheless the connection was made in some government mind between the Astronomer Royal and the railways.

The *Autobiography* relates that Lord Dalhousie, then President of the Board of Trade, approached Airy about his membership of the commission to enquire into the two different permanent way gauges employed in this country. On the one hand the Great Western Railway used the broad, seven feet, gauge while on the other the rest of the country's railways used a gauge of 4 feet 8½ inches. The difference of the gauges being, in Airy's words, "... of enormous inconvenience to the public".<sup>52</sup> Of the proposal to him Airy wrote "The Government determined to interfere ... I would act as second ... [with] Col. Sir Frederick Smith [and] Prof. Barlow ... I assented to this: and very soon began a vigorous course of business." Smith had been the Inspector General of Railways; Peter Barlow was professor of mathematics at the Woolwich military academy and the commissioners were appointed on 1845 July 9, a day on which Airy notes he saw Lord Dalhousie himself.<sup>53</sup>

Dalhousie plainly had confidence in Airy's ability to absorb extra responsibilities, and well-placed confidence it was. On the previous April 5 Airy had begun work with the tidal harbour commission, the first report of which is dated July 21, in the middle of the initial flush of activity with the railway gauge commission, and on the day Airy saw Dalhousie about the gauge commission he had earlier attended a meeting of the harbour commission.

There are still divided opinions about the rights and wrongs in deciding what was the better standard gauge for Britain's railways. Isambard Kingdom Brunel is an engineer and character who opposed the steam-roller of government and has his personal champions rather in the way that Barnes Wallis, another engineer who has challenged and opposed the received opinions of his day, is championed. A biographer of Brunel, L T C Rolt comments of Airy and Barlow "... the other two seem somewhat oddly chosen ... But ... it would have been impossible to find a distinguished engineer who was not an interested party".<sup>54</sup> Rolt continues "Knight, astronomer and mathematician, set to work with a will, devoting thirty days to the protracted examination of 48 witnesses, a total which included such seemingly irrelevant characters as Her Majesty's Inspector General of Fortifications".<sup>55</sup>

One thing to note from the archival record is the immense amount of effort and detail of examination that went into what was, after all, a small commission of three people. There are thirty-eight large volumes of correspondence and records relating to the gauge commission in the Airy papers of the Royal Greenwich Observatory Archives. All this was the labour of the three commissioners working, without the customary modern secretariat. The volumes commence with the commission correspondence,<sup>56</sup> continue with the written and printed minutes of interviews,<sup>57</sup> railway company replies to circulars,<sup>58</sup> correspondence and papers supplementary to the interviews,<sup>59</sup> booklets and printed material in support of one or other of the parties,<sup>60</sup> maps,<sup>61</sup> further booklets,<sup>62</sup> a G.W.R. directors' report,<sup>63</sup> related acts of parliament,<sup>64</sup> and further minutes, correspondence, circulars, and booklets.<sup>65</sup>

Though the taking of evidence took up the first intense work period of the commissioners a practical demonstration, in the form of a contest between a broad gauge and a narrow gauge locomotive that Brunel proposed, gave a rather comic turn to the proceedings. Rolt suggests that "Evidently this challenge appealed to the sporting instincts of the commissioners for they agreed ..."<sup>66</sup> to the contest. The broad gauge locomotive *Ixion* on a course between Paddington and Didcot returned an average speed of 53.9 m.p.h. hauling 60 tons whilst a narrow gauge locomotive running between Darlington and York could only manage a maximum speed of 53¾ m.p.h. pulling 50 tons.

On 1846 January 1 another narrow gauger named *Stephenson* ran off the rails during its run and a modern commentator on the event, E L Ahrons, has quipped "...the astronomer was not on board at the time or he might ... have seen some constellations such as he had never observed from Greenwich."<sup>67</sup> Airy's *Journal* version reads "1846 Jan 1 Thursday At York. Day not perfectly favourable, and a train was run merely for experiment on evaporation. The engine ran off the rails (at a broken joint-chain), the train was upset, and the fireman dangerously hurt. I left York by the night mail train".<sup>68</sup>

Of the New Year's Day entry it might be noted that from it is known (1) the purpose of the *Stephenson* run, (2) the weather conditions and (3) that someone was injured, information otherwise rarely available. It is typical of Airy's thoroughness. Early on the Friday morning Airy was back at Greenwich, working of course, and it was a very fine day. The Astronomer Royal's *Journal* certainly gives an immediacy to the events that is lacking in the other accounts.



Airy and the other commissioners were not deterred by the clear superiority of the broad gauge engines and the lack of success of the narrow gauge locomotives. Plainly the evidence they had heard from a majority of their forty-eight witnesses and other documentary evidence swayed them. No doubt there is much more to be culled from the Observatory records on quite what happened during the commission hearings and why the report was as it was. Whatever those details the important matter was that by 1846 January 29 the three commissioners had signed their report at Greenwich<sup>69</sup> and "... the business was concluded by the end of April. Our recommendation was that the narrow gauge should be carried throughout".<sup>70</sup> Though as Airy's further comment in the *Autobiography* makes clear, the business was not concluded as the recommendation was in practice ignored. The dual gauge solution, the broad and the narrow gauges both set side-by-side on the roadway, was run on the Great Western until the later years of the 19th century.

With the beginning of the gauge commission's activities in the summer of 1845, the vigorous course of business had unforeseen consequences. Within a year or eighteen months Airy's distraction with the gauge business would lead to the greatest criticism of his management of the Greenwich Observatory to which he would be subjected in his career. Though the incidents surrounding the discovery of the planet Neptune in 1846 are the subject of a scholarly paper by Allan Chapman, it is nonetheless proper to outline some of the circumstances to illustrate the tensions under which Airy was placed as director of the Royal Observatory and as a public servant.

The circumstances surrounding the discovery of the new planet in 1846 and why this was certainly not discovered from Greenwich, nor indeed from Airy's Alma Mater the Cambridge Observatory, but from Berlin are germane to this subject because the discovery was one of the triumphs of nineteenth century mathematical astronomy, the very stuff of Airy's qualifications. Yet Airy declined the chance to look for the planet at the place John Couch Adams predicted. Perhaps the Greenwich instruments were not ideal and the Northumberland telescope in Cambridge was better suited, but at the core, Airy did not consider his paid duty to be to look for new planets, however exciting this might be. Nor, indeed, how much this aroused public interest and public passion; "I was abused most savagely by both English and French." Airy commented.<sup>71</sup> With so much business being prosecuted on the gauge commission, with a heavily pregnant wife and a senior assistant arraigned for the murder of a child conceived in an incestuous relationship, Airy's eye was off the ball, in the modern phrase. In fact, Airy was on a continental 'rest-cure' holiday when he heard of the discovery of the new planet in 1846 September, so arduous had the previous year been, even for George Airy.

#### 4 THE EXTRANEOUS GOVERNMENT BUSINESS

From the list of subjects of this paper, naturally the title was self-selective. It will be noticed whence it comes, Airy's own title for a group of three volumes of papers. This was really Airy's 'catch-all' title to cover just about everything else that he had been asked to do in the years 1854-1880. This included various national and international exhibitions, lectures, work on examinations for South Africa, interviews for the public schools commission, correspondence on the 1870 education act, on a possible physical observatory, and his evidence to the Tay Bridge enquiry of 1879.

Already reference has been made to the tidal harbour commission. Other commissions that Airy served upon were:

##### 4.1 Ordnance Survey Commission

There is, of course, a natural connection between the Astronomer Royal and the geodetic survey of the country and it is hardly surprising that Airy served in this capacity.

##### 4.2 Lighthouse Commission

In Airy's papers there is one volume dated 1860-1861, including correspondence with Michael Faraday and William Gladstone, and the report of the commission as well as Airy's report on the Start Point lighthouse is dated 1860, Airy's involvement following an application for advice by Admiral Hamilton.

The 'utilities' commissions on which Airy served may be summarized as follows, really as an indication of his industry and the breadth of application of his skills that was required.

### 4.3 Sale of Town Gas Commission

There are eight volumes of papers preserved by Airy, dated 1858-1864, including correspondence, acts of parliament, circulars, plans, gas-holder designs, the parliamentary bills dated 1860 June 28 and 1863 March 17, papers on gas meters, and on the definition of a cubic foot of gas. Lord Mounteagle (formerly Thomas Spring Rice) had applied to Airy for assistance because of his work on the standards, and the latter definition as it related to the sale of gas.

### 4.4 Metropolitan Commission of Sewers

Public sanitation was a critical matter in the great cities of Britain as they grew enormously in the industrial age. The commission commenced work on 1848 October 28 and in the *Autobiography* Airy referred to the constitution as "... the most foolish that I ever knew – consisting of, I think, some 200 persons, who could not possibly attend to it. It came to an end the next year".<sup>72</sup> Nonetheless, Airy accumulated a further three volumes of papers, dated 1846-1849, including proceedings, reports, plans, correspondence, and suggested improvements in relation to the disposal of London's sewage. Airy had, as usual, practical ideas to put forward.

## 5 CONCLUSION

In this paper, reference is made on more than one occasion to the 25% of the Airy papers taken up by his 'extraneous' work. Of course, the corollary of this is that 75% of his time was taken up with doing everything else.

As Allan Chapman has written, in a fitting tribute "Looking at Airy's career during the mid-1840s in particular, it is astonishing to find one man called upon to fulfil so many exacting tasks all at the same time. In 1845-46 alone, he was providing meteorological data for the Registrar General, advising the Tidal Harbour Commission on the design of breakwaters at Plymouth and Cherbourg, suggesting improved sawing machines for Chatham Dockyard, and undertaking preliminary enquiries leading to the construction of the new Westminster Clock. He was also involved in correcting compasses for Admiralty postal vessels, advising on the design of the Menai tubular bridge, and, of course his work on the Railway Gauges Commission. None of these heavy demands were in the least concerned with astronomy, and it should also be remembered that at the Observatory, he was considering the introduction of a range of electrical self monitoring devices which in themselves amounted to a revolution in practical instrumentation. And when all the other extraneous demands had been met, he still faced the relentless task for which the state paid him; the collection, reduction and publication of the flawlessly accurate Greenwich Observations."<sup>73</sup>

## 6 NOTES

All references to MSS.RGO are from the Royal Greenwich Observatory *Handlist of the papers of George Biddell Airy in R.G.O.Archives* [unpublished catalogue to the manuscripts collection], Herstmonceux, 1985.

1. Airy (1896), chapter II.
2. Maunder (1900), p.108.
3. Chapman (1988a).
4. MS.RGO.6/1:f.195<sup>r</sup>.
5. Lovell (1994).
6. See for his account Airy (1896:104-109).
7. Maunder (1900:108).
8. Maunder (1900:116-117).
9. Wilfrid Airy: *In* Chapter I, Personal sketch of George Biddell Airy (Airy 1896:6-7).
10. Maunder (1900:118-119).
11. Maunder (1900:114).
12. Maunder (1900:118).
13. James South to the Lords Commissioners of the Admiralty, 1847 March 12, MS.RGO.6/2; quoted in Meadows (1975:3).

14. Airy (1896:123).
15. McCrea (1975:21).
16. Airy (1896:111-113).
17. Chapman (1988b).
18. McCrea (1975:28).
19. Chapman (1988b).
20. Meadows (1975).
21. Jones (1943:27).
22. Airy (1896:133); *Astronomer Royal's Journals* MS.RGO.6/24:f.24<sup>r</sup>.
23. Airy (1896:134).
24. Thomas Spring Rice, later Lord Monteagle, at this time Chancellor of the Exchequer.
25. *Astronomer Royal's Journals* MS.RGO.6/24:f.26<sup>r</sup>.
26. Airy (1896:134).
27. *Astronomer Royal's Journals* MSS.RGO.6/24-27.
28. *Astronomer Royal's Journals* MS.RGO.6/24:f.26<sup>r</sup>.
29. Airy (1896:134).
30. Clerke (1909).
31. MS.RGO.6/367.
32. MSS.RGO.6/338-339.
33. MSS.RGO.6/340-341.
34. MS.RGO.6/343.
35. MS.RGO.6/344.
36. MS.RGO.6/345.
37. MSS.RGO.6/346-347, 350-354.
38. MSS.RGO.6/348, 363-365.
39. MS.RGO.6/349.
40. MS.RGO.6/355.
41. MSS.RGO.6/356-359, 361, 366-367.
42. Airy (1857).
43. Chapman (1988b), and Airy's papers relating to the Coinage Commission, MS.RGO.6/446.
44. See entries for the dates in *Astronomer Royal's Journals* MS.RGO.6/24:f.28<sup>r</sup> *et seq.*
45. Airy (1839) and Airy (1855).
46. Turner (1892).
47. Turner (1892:223).
48. Herschel (1844).
49. Clerke (1909).
50. *Astronomer Royal's Journals* MS.RGO.6/24: f.1<sup>r</sup>.
51. See for this period Airy (1896:126).
52. Airy (1896:171).
53. *Ibid.*; MS.RGO.6/24:f.100<sup>v</sup>.
54. Rolt (1957:199).
55. Rolt (1957:199).
56. MS.RGO.6/284.
57. MSS.RGO.6/285-290.
58. MS.RGO.6/291.
59. As if there were not enough already, see MS.RGO.6/292.
60. MSS.RGO.6/293-299.
61. MS.RGO.6/300.
62. MSS.RGO.6/301-306.
63. MS.RGO.6/307.
64. MS.RGO.6/308.
65. MSS.RGO.6/309-321.
66. Rolt (1957:200).
67. *Ibid.* p.201.
68. *Astronomer Royal's Journals* MS.RGO.6/24:f.106<sup>r</sup>.
69. *Astronomer Royal's Journals* MS.RGO.6/24:f.106<sup>v</sup>.

- 70. Airy (1896:180).
- 71. Airy (1896:181).
- 72. Airy (1896:196).
- 73. Chapman 1988b.

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