A DISCUSSION OF THE EVALUATIVE PROCESS OF NEVIL MASKELYNE AND THE COMMISSION OF THE BOARD OF LONGITUDE IN ASSESSING THE VIABILITY OF JOHN HARRISON'S H4 CLOCK IN 1765

INTRODUCTION

During and prior to the eighteenth century several European states sought to increase their political, military and economic power.[1] One of the principal ways this was realised was through the establishment of colonies and trade routes around the world.[2] A vital component of this expansion, both economically and militarily, were the navies of these powers.[3] Voyages at sea in the eighteenth century were often hazardous, with ships, crews and cargoes being lost to a variety of perils, often caused or influenced by navigational error.[4] Navigation at sea was far from an exact process during much of the eighteenth century, determining latitude was practicable by examining the positions of stars in the night sky; determining longitude however was far more challenging.[5]

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[1] Anderson, Matthew Smith. *Europe in the Eighteenth Century: 1713-1783*. Longmans, Green, 1961: 238-9, 242, 271; and also Fernie, J. Donald. 'Marginalia: The Harrison-Maskelyne Affair.' *American Scientist* 91, No. 5 (September-October 2003): 403-5.

[2] Ibid. 403.

[3] Ibid. 403; and also Pumfrey, Stephen. ''O Tempora, O Magnes!' A Sociological Analysis of the Discovery of Secular Magnetic Variation in 1634.' *The British Journal for the History of Science* 22, no. 2 (July, 1989): 181-214, pp. 190-1; and also Smith, 259; Stewart, Larry. 'Other Centres of Calculation, or, Where the Royal Society Didn't Count: Commerce, Coffee-Houses and Natural Philosophy in Early Modern London.' *The British Journal for the History of Science* 32, No. 2, (June, 1999): 133-153, pp. 148.

[4] Johnson, Sherry. 'Climate, Community, and Commerce among Florida, Cuba, and the Atlantic World.' *The Florida Historical Quarterly* 80, no. 4 (2002): 455-482, pp. 461-2; and also Fernie, 403; and also Stewart, 149.

[5] Ibid. 403; and also Andrews, Loring B. 'The Astronomy of Navigation.' *The Scientific Monthly* 40, No. 4 (April 1935): 360-363, pp. 361.

There was no widely accepted and practicable way of determining longitude at sea for much of the eighteenth century. However Newton, Halley and others had suggested that a solution may lie in finding a way to keep the time of a home port, or suitable place where the longitude was established (for the English, this was the Royal Observatory at Greenwich), and comparing it to the observed time at the ship's current location at sea.[6] The difference in time, ahead or behind of the base time, would determine how many degrees of longitude East or West the ship was of that base location.[7] There was though, at the start of the eighteenth century, no way of reliably keeping time at sea.[8] Several European nations instituted awards for the discovery of a way of determining longitude at sea.[9] In England this manifested in the Longitude Act of 1714, which established a Board of Longitude for investigating proposed techniques for finding longitude at sea, with a reward of £20,000 for a successful method.[10] In order to classify as successful, the technique had to reliably find the longitude at sea to within half a degree, and be practicable and useful across the multitudinous ships of the Royal and Merchant navies.[11] As such the Board's responsibilities were substantial, as the technique it patronised would come to be depended on by countless lives, as well as relied upon by the state to project national power and pride, as well as further economic growth.[12]

For several years a variety of impractical, spurious or even fraudulent suggestions were brought to the attention of the Board, and it was not until the mid-1730s that a potentially viable contender was brought to the fore, with John Harrison's H1

[6] Robinson, H. W. 'Gleanings from the Library-II.' *Notes and Records of the Royal Society of London* 2, No. 1 (April, 1939): 68-70, pp. 68; and also Barrett, K. ''Explaining' themselves: The Barrington papers, the Board of Longitude, and the fate of John Harrison' *Notes and Records of the Royal Society* 65, (January, 2011): 145-162, pp. 150; and also 'Barrington Papers.' National Maritime Museum, Greenwich, London, MS BGN/1 (henceforth referenced by MS number only).
[7] Fernie, 403.
[8] Ibid. 403; and also 'Papers of the Board of Longitude.' Cambridge University Library, RGO 14/1: 10-97 (henceforth referenced by RGO number only).
[9] Fernie, 403.
[10] Barrett, 145; and also Robinson, 68; and also Fernie, 403; and also Bennett, Jim. 'The Trials and Travels of Mr. Harrison's Timekeeper.' In Marie Noëlle Bourguet, Christian Licoppe, and H. Otto Sibum (eds.) *Instruments, Travel and Science: Itineraries of Precision from the Seventeenth to the Tewentieth Century*. London, Routelege, 2002: 79-95, pp.75; and also RGO 14/1, 10-97.
[11] Bennett, 76, 80-2; and also Fernie, 403; and also RGO 14/5, 77; and also RGO 14/1, 10-97.
[12] Bennett, 76; and also Fernie, 403.

clock.[13] The clock, if it functioned as intended, would allow a ship to keep Greenwich Time at sea, allowing the calculation of longitude. An alternate method being developed at the time, which the Board was also aware of, was that of lunar distances.[14] This would allow the determination of Greenwich Time from the relative positions of the moon and other celestial bodies, which could be used to correct shipboard clocks and to calculate longitude by comparing local time (which required sight of the sun) with Greenwich time the next day. The lunar distance method was favoured by several, including in later years Nevil Maskelyne, a possible contender for the prize who sat on the Board upon becoming Astronomer Royal in 1765.[15] During that same year Harrison's improved H4 was found to have successfully kept time at sea following test voyages, and allowed calculation of longitude with sufficient accuracy to justify the full £20,000 reward stipulated in the 1714 Act.[16] However, the Board of Longitude refused to award the prize, infuriating Harrison and exacerbating fractions between him and his associates, and the Board, leading to public campaigns and appeals to parliament and the king, George III, for support.[17]

THE EVALUATIVE PROCESS OF THE BOARD OF LONGITUDE

The actions of the Board of Longitude can almost always be seen to have passed through a painstaking filter of caution and consideration.[18] Whilst John Harrison, and his son, William, were trying to win the Longitude Prize, there were a great many conflicting interests at work both within and without the Board, which it was the Board's public duty to navigate and negotiate.[19] Over the forty or so years that John Harrison tried to win the Longitude Prize, he tried a broad variety of methods,

[13] Ibid: 403; and also Robinson, 68; and also RGO 14/5, 3-6; and also Schaffer, Simon. 'Papers of the Board of Longitude.' Cambridge Digital Library, May 23rd, 2014. http://cudl.lib.cam.ac.uk/collections/rgo14#1; and also Sorrenson, Richard. 'George Graham, Visible Technician' *The British Journal for the History of Science* 32, No. 2 (June 1999): 203-221, pp. 217-8.
[14] Bennett, 77, 84; and also Fernie, 403.
[15] Bennett, 86; and also Barrett, 147; and also Fernie, 404-5; and also RGO 14/5: 69-70, 75; and also Sorrenson, 219.
[16] Bennett, 86; and also RGO 14/5: 75-7.
[17] Fernie, 404-5; and also Bennett, 75-6; and also 'Papers of Nevil Maskelyne.' Cambridge Digital Library, RGO 4/187:48:1r-2v (henceforth referenced by RGO number only).
[18] Bennett, 75-6; and also RGO 14/5-8.
[19] Bennett, 75-8.

and the Board's own methods of appraisement and testing developed similarly over the course of its existence.[20]

TRIALS

As it became increasingly apparent to the Board that potentially viable methods were being brought forward, and that public pressure for them to discharge their civic duty was growing, the Board's concerns began to spread beyond that of its original remit.[21] If it were to properly fulfil their responsibilities as outlined in the Act of 1714, it would need to define the parameters of the Act. What constituted a 'practicable and usefull [sic]' method for finding the longitude at sea?[22] Did an instrument constitute a method? Or was a greater understanding of and technique for managing the relations between the passage of time and location on the earth required to merit the prize?[23] On a more mundane level, even if the instruments were to qualify, the Board would have to determine that they could not only keep time accurately, but could travel successfully in the wide variety of conditions found at sea.[24] Only if an instrument could travel successfully would it be of any use to British mariners, regardless of how accurately it kept time. Considerable durability and reliability of any technique was therefore a significant criterion for the Board.[25]

In order to avoid awarding the prize to a device which turned out to be unreliable at sea, each proposed technique needed to be tested rigorously.[26] It is for this reason that the Board arranged several sea trials for promising methods, including Harrison's timekeeper. Harrison's H1 clock was sent on a trial voyage to Lisbon in 1735, and following improvements and developments by Harrison to improve the design, far more extensive trans-Atlantic trials were arranged for H4 a quarter of a

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[20] Ibid, 75.
[21] Ibid, 75-7; and also Barrett, 146-7.
[22] RGO 14/1, 10-97; and also RGO 14/5, 77.
[23] Bennett, 79-82.
[24] Ibid, 76; and also RGO 4/152, 4r-6v.
[25] Bennett, 75-7; and also RGO 14/1, 10-97.
[26] RGO 4/321, 7v-43v; and also RGO 14/5, 24-5.

century later.[27] Thorough evaluation of any contender for the Longitude Prize was clearly a priority for the Board's members.

When Harrison brought his H4 clock to the attention of the Board and requested that it be taken on a sea-trial in 1761, the Board's members agreed fairly readily. This was not only due the Board members' desire for a thorough evaluative process. The Board had invested heavily in Harrison over the years, giving him thousands of pounds to develop his ideas, and quickly began drawing up plans for a full sea-trial of Harrison's H4 clock in 1761.[28] This perhaps can indicate a source of bias in the evaluative process of the Board; investment in any proposed solution might suggest that the Board then had an interest in seeing it succeed, as stopping support to any such technique once funded could be seen as a waste of public money.

With the assistance of the Royal Society, the Board formulated a plan for a trans-Atlantic sea trial of an instrument for finding longitude, for which there was no precedent to hand.[29] The intentions of the trial and the commissioners' desire for rigorous evaluation can be seen through an examination of its protocols as agreed by the Board and the Royal Society. Harrison's timekeepers (two were submitted for the trial) would be set at Portsmouth by the first master of the Royal Naval Academy, John Robertson. Robertson was known to the Board and to London academic society as a reliable and credible individual, who was trusted for his impartiality and diligence.[30] It seems that the Board selected him because they knew him to be reliable from other trials and tests he had helped run.

Harrison's son, who would be accompanying the timekeepers on their trial, was to be observed at all times by several ship's officers to ensure that there was no tampering with the device. The times shown on the timekeepers would be recorded daily, and always with more than one person present to ensure that there was no tampering or significant human error. A person competent in determining time by observation of the sun would be sent on board the ship to make an accurate

[27] Fernie, 404-5; and also Bennett, 76-88.
[28] RGO 14/5, 26-9.
[29] Ibid, 28-9, 30-1; and also Bennett, 76-7.
[30] Ibid, 76-7; and also RGO 14/5, 37-8, 50-1.

determination of the time in the destination port in Jamaica, the trial's destination. Once the time had been determined, it would be noted down and compared to the time shown on Harrison's timekeepers, again before witnesses to minimise the chances of tampering and error. The results of this comparison would be sent under seal back to the Admiralty in England so that they could be considered outside of the influence of the invested individuals engaged in the trial. The individual who determined the time in Jamaica, or someone equally qualified who had been aboard ship, would then determine the longitude at port in Jamaica as best as possible, by observation of the eclipses of Jupiter's satellites, and the same observation would be made in Portsmouth by Nathaniel Bliss, a professor of Geometry at Oxford.[31] These observations would be made using duplicate instruments, to reduce sources of error affecting one observation over another. It could be argued that the planning of this sea trial shows that the members of the Board were trying to minimise sources of human error, bias, and interference with the results, in order to allow them to make a sound evaluation of the timekeeper's merits.

On the whole it can be seen that the proposed trial process had, throughout, a focus on impartiality and rigorous testing. The Board's members clearly wanted to use the results of the trial to determine whether Harrison's clock was truly viable at sea for determining longitude. The process that they had formulated meant that every measurement and decision would be witnessed by others, and sought to minimise sources of error at every step.

It is however the case that the determination of longitude by the observation of Jupiter's satellites was not a straightforward process, and there was considerable scope for human error and misjudgement.[32] The observations themselves required considerable practice on the part of the observer, and as such it couldn't be guaranteed that, even if witnessed, the observer would not be able to doctor the results of their observations. Some sources of error were removed by insisting on the use of duplicate instruments, that way the observers in Jamaica and Portsmouth

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[31] Bennett, 77.
[32] Ibid, 77; and also RGO 14/5, 31; and also Helden, Albert Van, 'The Invention of the Telescope', *Transactions of the American Philosophical Society* New Series 67, No. 4 (1977): 1–67, pp. 58.

would receive roughly the same range of data, but there was no guarantee that they would perceive what they saw in the same way. In addition, manufacture of the reflecting telescopes being used in these observations was carried out by hand, and even if they were made by the same person to be identical, they would not be so.[33] This was not so much a product of poor process however (there was no real alternative); merely naivety on the part of the Board's members in allowing such a large source of error into an otherwise very carefully thought out trial. This naivety can be, to a certain extent ameliorated by knowledge that this was the first real trial of its kind, and by the technological constraints of the time.[34]

Harrison however protested the Board's plan for a trial, in all likelihood because the person chosen to captain the ship the trial would take place on had previously led voyages to test Mayer's reflecting circle on behalf of the Board, which was connected with the rival lunar distance method of finding longitude at sea.[35] That Harrison should see this as a potential source of bias is not particularly surprising, and again it seems naïve of the board to have appointed an officer (albeit a very experienced one) with such a history and not to have expected objections.[36]

As such the plan was modified slightly, maintaining and even increasing the number of witnesses and checks aboard ship to ensure that the timekeeper was not tampered with, and that the observations made of it were fair and correct, and the trial was arranged to coincide with the voyage of the newly appointed governor of Jamaica, William Lyttleton.[37] Unusually, there was no substitute offered for the land-based determination of longitude by the observation of Jupiter's satellites.[38] This meant that the observations of longitude determined by the time differential shown by Harrison's clock wouldn't have a reliable baseline to compare them to, only existing estimates for the longitude of the port in Jamaica.[39] This may perhaps indicate that the concern of the Board was in fact whether Harrison's clock could

33 Bennett, 77.
34 Ibid, 76.
35 Ibid, 77.
36 RGO 14/5, 30-1.
37 Ibid, 32.
38 Ibid, 30-3.
39 Ibid, 30-4; and also Bennett, 77-8.

simply keep time aboard ship, as if it could be proven to do so, then the overlying methodology of determining longitude by time differential could follow on proven foundations. Without this inference it seems a singularly bizarre omission by the Board, as it nullifies the ostensive point of the trial.

The decision to allow the trial to coincide with governor Lyttleton's voyage not only helped ensure the trial took place as soon as possible following Harrison's objections, but also helped save expenditure by the Board by taking advantage of an independently arranged voyage to Jamaica. The planning and organisation of this first trans-Atlantic trial shows that the Board was trying to create a fair and balanced trial of the watch, from which they would be able to judge the value of Harrison's timekeeper to the nation, as well as minimising public expenditure. The focus of the Board's attention, therefore, seems predominantly to be civic duty, and its evaluative process can be seen to reflect that attention. By impartially trialling every method the Board's members thought viable, the method chosen to win would be the one most likely to be of use to the public and the nation.

The results of the 1761 trial however did not work in Harrison's favour. Many of the planned procedures were sloppily undertaken and supervision was poor; many parts of the Board's plan had not been followed as they should have been.[40] The Board's members found that the ability of the watch to keep time at sea were insufficient to make it a suitable instrument for determining longitude.[41] However the Board could see that the clock, with some improvement, could prove an extremely valuable tool at sea, and as it was at present, served some use for advances in clock making.[42] As such Harrison was awarded a smaller, but still substantial sum of money, £2500, and ordered to prepare his watch for a further trial, as well as asked to explain the workings of his clock to the Board so that it might be better understood.[43] Whilst Harrison failed to demonstrate the working of his watch to the satisfaction of the Board, the second trial went ahead. This second trial, and pecuniary encouragement by the Board, shows that they were extremely

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[40] Bennett, 79-80; and also RGO 14/5, 36-7.
[41] Ibid, 38.
[42] Ibid, 38.
[43] Ibid, 38, 45; and also Barrett, 147.

supportive of Harrison's device, especially considering that they were still not satisfied that it could be reproduced following Harrison's failed attempts to demonstrate the workings of the watch without dismantling it.[44] It also showed that the members of the Board understood that a failed trial does not guarantee future failure, just as, they would come to claim, a successful trial does not guarantee future success. Understanding that the first trial had not been carried out to their designs, the Board's members were willing to allow a second so that they could make an accurate determination, again their evaluative process is well founded.

The second trial, to Barbados in 1764, was similarly arranged efficiently, as it not only served to test Harrison's clock, but also Mayer's method of lunar distances and Irwin's Marine Chair.[45] The instance on trials for multiple methods indicates a clear desire on the part of the Board's members to evaluate proposed techniques and methods fully. This again reflects the commissioners' general attitude to their civic duty, as they attempted to ensure that when they chose a technique to win the prize, it would be one which could be used, and useful, across all of the nation's vessels. In addition the organisation of multiple trials on the same voyage again highlights both the Board's desire to discharge its responsibilities as swiftly as possible (sea voyages, and therefore trials, were very time consuming), as well as it's awareness that it was spending public money, and should therefore be financially responsible. The Board therefore can be seen to be more diligent and careful in its evaluations than the reckless, inept body often portrayed in popular historical accounts.[46]

This second test was much more fruitful for Harrison. With the acknowledgement of a steady losing rate, H4 was found to have reliably kept time at sea to allow the calculation of longitude well within the limits set forth in the Longitude Act.[47] Harrison appealed to the Board for a certificate granting him the Longitude Prize, but was unsuccessful.

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[44] Barrett, 145-7; and also Bennett, 82-4.
[45] Ibid, 85-6; and also RGO 14/5, 67-8, 72.
[46] Fernie, 405; and also Sobel, Dava. *Longitude : The True Story of a Lone Genius Who Solved the Greatest Scientific Problem of His Time*. London: Fourth Estate, 1996.
[47] RGO 14/5, 74, 76-7.

According to the wording of the original 1714 Act, should any technique or device pass such a trial with sufficient accuracy, its creator would be awarded a substantial sum of money, £20,000 (approximately £3.75m in 2014), by the treasury.[48] However when it became clear that Harrison's watch may qualify for the prize, the commissioners began to consider the wording of the original act in more care, again with attention to their civic duty. Choosing the wrong technique would have ramifications far beyond merely wasting money.[49]

The Board were increasingly aware that fulfilling the terms of the original Act for award of the prize (as Harrison's watch had done) was not necessarily the same thing as finding the longitude at sea using a method which was practicable and useful.[50] The Board's members could not be certain that Harrison's method, even though the second trial had proven successful, would be the correct choice for a broadly practicable and useful method for determining longitude at sea.[51] This is the principle reason that, in one of the most significant meetings of the Board on the 9th of February in 1765, having proven that his device had worked Harrison was not granted the full reward as stipulated in the original act. The Board instead passed two Acts of parliament, one of which awarded Harrison half of the total prize, £10,000, and ordered that he make the workings and manufacture of his clock known to the Board and to watchmakers of their choosing, so that copies could be made and tested. In this way, the commissioners would be able to determine that Harrison's method of timekeeping could be duplicated and applied to other vessels, therefore fulfilling the requirements of practicability and utility outlined in the original Longitude act of 1714.[52] These new criteria for winning the prize (revealing the workings of any method so as to allow it to be duplicated) were similarly supported in a new act of parliament passed in 1765.

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48 RGO 14/1, 10-97; and also Bennett, 76; and also Bank of England Inflation Calculator, accessed May 25th, 2014.
http://www.bankofengland.co.uk/education/Pages/inflation/calculator/flash/default.aspx .
49 Bennett, 76; and also Fernie, 403; and also Smith, 165-6.
50 Bennett, 80; and also RGO 14/1, 10-97; and also RGO 14/5, 77.
51 Ibid, 77; and also Bennett, 80-8.
52 Ibid 77-8.

THE ACTS OF PARLIAMENT

The desire of the members of the Board to have Harrison's designs (and any future techniques brought to their attention) explained in full could be seen in two ways. Either the Board was attempting to delay Harrison's award of the prize in the hope that another method would prove fruitful, or the Board-members were simply trying to ensure that Harrison's clock, which had been shown to work in the second trial, could be duplicated and used on multiple vessels and voyages. There is evidence to support both inferences, and indeed they are not mutually exclusive. In 1765 the Board sought to expand, explain, and redefine its powers, and the criteria necessary to win the Longitude Prize, in two Acts of parliament, drafted and presented by politician and board-member William Barrington.[53]

The second of these Acts dealt, in part, with Harrison specifically, and led to the creation of a second board of commissioners, whose sole function was to manage and oversee the 'discovery' of Harrison's clocks.[54] This was a legacy of the failed attempts to gain full understanding and disclosure of the devices after the first trans-Atlantic trial in 1763, and it seems to have been hoped that enshrining and defining the need for full disclosure and explanation in an Act of parliament would help persuade Harrison to cooperate.[55] Provided that this discovery was successful, and the commission was satisfied that the clocks could be reproduced and used by others, Harrison would receive the full Longitude prize. This second commission was made up predominantly of clockmakers & Royal Society members, and the Acts creating it were deliberately vague about the commission's remit, as well as the scope of the explanations and demonstrations that Harrison (and others) would have to make.[56] The Board's members therefore, having evaluated the functionality of Harrison's clock, were now trying to encourage him to allow them to evaluate its broader viability in practical use through duplication and external trial.

The Acts also increased the amount of money that the Board was allowed to spend, including a specific dispensation for giving money to other successful longitude

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[53] Barrett, 145-7; and also MS BGN 8:1; and also Bennett, 82.
[54] Ibid, 82; and also RGO 4/152; and also Barrett, 147.
[55] Barrett, 146-8.
[56] Barrett, 147-8; and also Bennett, 86-8.

solutions in the event that Harrison won the full prize anyway.[57] This not only showed a continuing desire on the part of most members of the Board to support viable and useful longitude solutions for the benefit of marine travel and national prowess, but a growing awareness that they may need to award Harrison the prize even if they weren't sure how to replicate his clock.

These Acts helped ensure that all future innovations and techniques brought before the Board would be treated in the same way, and as the new Acts superseded the wording of the original Longitude Act of 1714 it may have been hoped by the Board's members that Harrison's claims to have met the terms of the original Act (which he had done in the second trial) and to therefore be awarded the full prize would be muted.[58] The general interests of the Board's members, however, appear to remain those of public service and ensuring the prize is awarded to the correct method, especially when the work of Tobias Mayer in producing his lunar tables in 1755 made the lunar distance method, extensively tested by Nevil Maskelyne, among others, more viable than before for determining Longitude at sea.[59] The motives of the Board's members do not have appeared to be confused or even malevolent, as has been suggested in previous literature.[60] The main issue was no longer whether Harrison's clock allowed the calculation of Longitude at sea or not, it was whether others could build and use ones like it, concern that it could not be duplicated is part of what led to the Board withholding the prize from Harrison, they had evaluated the timekeeper and determined that it was functional, but not whether it was viable.

NEVIL MASKELYNE

[57] RGO 14/5, 74.
[58] Bennett, 86-8; and also Meisenzahl, Ralf, and Joel Mokyr, *The Rate and Direction of Invention in the British Industrial Revolution: Incentives and Institutions* (April 2011): 1-47 <http://www.nber.org/papers/w16993> [accessed 30 May 2014], pp. 32-3.
[59] 'Johann Tobias Mayer (German Astronomer) -- Britannica Online Encyclopedia' <http://www.britannica.com/EBchecked/topic/370940/Johann-Tobias-Mayer> [accessed 27 May 2014]; and also Barrett, 147.
[60] Sobel, *Longitude*.

The Lunar Distance method of determining longitude at sea had developed almost in parallel with Harrison's timekeepers.[61] It relied on a completely different set of data and instruments to determine longitude by the position of the moon in the night sky relative to certain celestial objects to determine the time in Greenwich, from which longitude can be calculated. One of the co-developers and testers of this method was Nevil Maskelyne.[62] He was well known to the Board, and had trialled both the marine chair and lunar distance methods, the latter of which he favoured.[63] The members of the Board found him to be reliable and often sought his counsel and input, as well as often sending him on trials and observations.[64] Maskelyne's presence was so dearly sought on the second trial of Harrison's timekeeper that the destination of the voyage was moved from Jamaica to Barbados as Maskelyne was not willing to travel to Jamaica on health grounds.[65]

Problems for the Board however arose when Maskelyne was, very promptly upon returning from a trial arranged by the Board, made Astronomer Royal, in 1765.[66] As such he no longer merely did work for the Board, he was a member.[67] As Astronomer Royal he was given custody of H4 and conducted numerous tests on it at the Royal Observatory at Greenwich, where he found it to lose time at an unpredictable rate, rendering it, practically, useless.[68] Maskelyne had already been accused of bias by John Harrison's son, William, during the course of the second trial of Harrison's timekeeper, and his elevation to serve on the Board seemed to, at least to Harrison, introduce an intolerable level of bias to the decision making process of an already highly diverse board of individuals.[69]

[61] Barrett, 147.
[62] Ibid, 174; and also Bennett, 86.
[63] Barrett, 174; and also Bennett, 86; and also RGO 14/5 63, 67; and also RGO 4/321; and also RGO 4/150; and also RGO 4/320, 7:1r.
[64] RGO 14/5.
[65] RGO 14/5 55-6.
[66] Barrett, 147; and also Bennett, 87-8; and also RGO 14/5, 75.
[67] Bennett, 76; and also RGO 14/5, 75.
[68] Bennett, 89-91; and also Fernie, 404-5; and also RGO 4/312; and also RGO 4/311; and also 'Sandwich Papers.' National Maritime Museum, Greenwich, London, SAN/F/2, 22:1 (henceforth referenced by SAN number only).
[69] Bennett, 75-6, 86, 89-91; and also Barrett 146; and also RGO 14/5, 3, 22, 75, 199.

No doubt caused in part by Maskelyne's presence on the Board, and by the commissioners' reluctance to award Harrison the prize despite his meeting the original terms of the Longitude Act, Harrison changed the focus of his efforts. He refused to make further explanations and discoveries of his watch than had been attempted prior to the second trial, and ceased dealing with the board in general, instead appealing beyond the Board and directly to parliament and the king.[70] This campaign was highly successful, with Harrison being awarded the remainder of the Longitude prize by order of the king in 1773.[71]

CONCLUSIONS

Over decades of investigation and trial, the Board of Longitude encouraged and directly supported the development of Harrison's timekeeper. The members of the Board sought to test the timekeepers in as unbiased and balanced way as possible. The hope of the Board's members seems to have been that minimising sources of bias and error in the testing of the timekeepers would allow an impartial evaluation of the functioning of Harrison's clocks. Flaws in the first trial led to a retrial, highlighting the commissioners' desire for accurate data on which to base their findings. There were flaws in the original wording of the Act, and the Board's members appeared naive more than once, but its members learned swiftly and clarification in the 1765 Acts that Board members were not eligible for the prize helped reduce internal conflicts of interest considerably.[72]

The failure of Harrison to fully explain and reveal the workings and manufacture of his clock to the commissioners' satisfaction was the reason he wasn't awarded the Longitude Prize following the successful second trial of 1764. The Board's members were satisfied that Harrison's timekeeper worked, but they were not satisfied that it was a viable solution to the longitude problem. This was because, function as it may, alone it was a curiosity: only in large numbers would it serve as a solution, and without adequate discovery of Harrison's watch, the commissioners did not feel

70 Bennett, 75-6; and also Fernie, 405; and also SAN/F/2, 22:1; and also RGO 4/187, 48:1r.
71 Bennett, 75; and also Fernie, 405.
72 BGN/10:1; and also Barrett, 152.

sure that it could ever exist in large numbers, let alone function. The failure on the Board's part, was in communicating this to Harrison.

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