The politics of musical standardization in nineteenth-century France and Britain

In 1859 the eminent British astronomer John Herschel identified that there were three fundamental measures of the universe. For time, seconds divided the day into aliquot parts. Meters or yards, depending on where you were, provided standards of space. Completing this 'natural metrical system' was the measure of music or, more precisely, what sound, expressed in terms of the number of vibrations per second, should musicians tune their instruments to? For Herschel, mathematics provided an infallible answer. Based on the calculation that a string vibrating once a second produced an inaudible C, and that each octave of this note could be derived by halving the string's length, Herschel asserted that C-above-middle-C would sound at 512 vibrations.[1] In advocating this third of universal standards, Herschel envisaged a measure which referenced nature in the same manner as the French metre and boasted that in this matter he was 'more French than the French'.[2] As mid-Victorian Britain's most eminent 'gentleman of science', Herschel commanded respect over the measure of time and space.[3] But the measure of musical pitch went beyond mathematics, engendering physiological questions over the voice, historical notions of what pitch had been in the past, religious concerns about sung worship, aesthetic tensions regarding the sound of pitches, and the professional interests of musicians and instrument makers.

Despite its significance for contemporary audiences, the uniformed regulation of musical pitch has received little historical attention. This article argues that, as Herschel asserted, music was a central part of nineteenth-century standardization, uniting scientific, political, and artistic concerns. Involving the regulation of an art that was central to local

[1] Each halving of the string's length increased the number of vibrations to the power of two (2, 4, 8, 16, 32, 64, 128, 256, 512 …).
[2] John Herschel, 'Uniform musical pitch', *Leeds Mercury*, (Leeds, England), 2nd August 1859; issue 6985.
[3] As defined in, Jack Morrell and Arnold Thackray, *Gentlemen of Science: early years of the British Association for the Advancement of Science*, (Oxford University Press: Oxford, 1981); on Herschel and the measure of space see, Simon Schaffer, 'Metrology, Metrication, and Victorian Values', in Bernard Lightman (ed.), *Victorian Science in Context*, (Chicago University of Press: Chicago, 1997), pp. 438-74, 443-9.

identities, musical standardization offers historical insights into mid-nineteenth-century Anglo-French political culture. These two countries had diverse musical traditions, which included varying singing and instrumental practices, from Catholic *maîtrises* and Anglican choirs, to municipal brass bands and secular vocal societies. For all that Herschel idealized music as a mathematical product, its social character meant that a standard musical pitch could never be a purely scientific problem. By comparing efforts to introduce unified measures of musical pitch in France and Britain between 1858 and 1860, we demonstrate how the differing political cultures of these states shaped the production of two alternative standards. Emphasizing how it was difficult for different countries to adopt the same standard without shared political values, this article enhances our historical understanding of national, and international, processes of unifying measures.

In 1858, Emperor Napoléon III's government established a commission to determine what France's national musical pitch should be. The concept of a standard pitch had its origins in the work of natural philosophers Marin Mersenne (1588-1648), Joseph Sauveur (1653-1716), and Ernst Chladni (1756-1827), but by the mid-nineteenth century concerns over musical unification had become urgent. There was a growing sense that since the start of the century, the pitches at which orchestras had been playing had risen to the detriment of vocalists. At the same time, the showcasing of instruments at the 1851 Great Exhibition in London and the 1855 *Exposition Universelle* in Paris had drawn attention to international disparities in pitch. In 1859, Napoléon's commission established a standard, known as the *diapason normal*. Within months, the British Society of Arts followed suit with an inquiry of its own which, in 1860, proposed an unifying musical pitch at a slightly lower frequency than the French standard.

These efforts to regulate French and British musical practice took place at a moment of intense interest in unified systems of measurement. Historians have demonstrated how standard

units carried immense commercial and scientific value in nineteenth-century Europe: accurate measures of heat allowed for efficient steam engines, reliable time ordered railways, and unified weights and measures underpinned trade.[4] These standards were determined through collaborations between mathematicians, engineers, and natural philosophers. Different cultural values shaped alternate understandings of what was precise, what made a standard credible, and who could be trusted to produce it, while uniformed measures were frequently objects of national and institutional competition.[5] As Bruce Hunt and Simon Schaffer have shown, physicists and telegraph engineers worked together on the British Association for the Advancement of Science's 1861 Electrical Standards Committee to produce increasingly accurate electrical measures.[6] But it was not until the International Electrical Congress, held in Paris in 1881, that a multilateral agreement was reached over the adoption of the ohm, volt, farad, coulomb, and ampere.[7]

Although coinciding with these investigations into electrical standards, the case of music was very different. Surrounding this art was a diverse body of interested parties, from both the scientific and musical communities. Pitch unification was not principally the product of industrial factories or physics laboratories, but was the concern of opera houses, churches, concert halls, music salons, and instrument workshops. Crucially, while other units of

[4] For studies of standards see, M. Norton Wise and Crosbie Smith, 'Measurement, Work and Industry in Lord Kelvin's Britain', *Historical Studies in the Physical and Biological Sciences*, Vol. 17, No. 1, (1986), pp. 147-73; Heinz Otto Sibum, 'Reworking the mechanical value of heat: instruments of precision and gestures of accuracy in early-Victorian England', *Studies in the History and Philosophy of Science*, Vol. 26, No. 1, (1995), pp. 73-106.
[5] Graeme J. N. Gooday, *The Morals of Measurement: accuracy, irony, and trust in late Victorian electrical practice*, (Cambridge University Press: Cambridge, 2004), pp. 1-3 and 23-30; also see, Theodore M. Porter, *Trust in Numbers: the pursuit of objectivity in science and public life*, (Princeton University Press: Princeton, 1996).
[6] Bruce J. Hunt, 'The Ohm is where the art is: British telegraph engineers and the development of electrical standards', *Osiris*, Vol. 9, Instruments, (1994), pp. 48-63; also see, Crosbie Smith and M. Norton Wise, *Energy and Empire: a biographical study of Lord Kelvin*, (Cambridge University Press: Cambridge, 1989), pp. 684-98; Simon Schaffer, 'Late Victorian Metrology and its Instrumentation: a manufactory of Ohms', in Mario Biagioli (ed.), *The Science Studies Reader*, (Routledge: New York, 1999), pp. 457-78; Simon Schaffer, 'Physics laboratories and the Victorian country house', in Crosbie Smith and Jon Agar (eds.), *Making Space for Science: territorial themes in the shaping of knowledge*, (Macmillan Press Ltd: Basingstoke, 1998), pp. 149-80; for studies on precision see, M. Norton Wise (ed.), *The Values of Precision*, (Princeton University Press: Princeton, 1995).
[7] Simon Schaffer, 'Rayleigh and the establishment of electrical standards', *European Journal of Physics*, Vol. 15, (1994), pp. 277-85.

measurement were designed to produce unification over geographical space, the creation of a standard pitch was first and foremost referenced to historical composition and intended to secure continuity with past and present musical culture.[8]

Our analysis goes much further and shows that pitch standardization also raised profound political tensions over the government's role in a liberal society. In the 1850s, British politics was primarily characterized by a commitment to preserving the personal freedoms of the individual and a low level of state intervention in the nation's economic and social life. There was an assumption that while European absolutist regimes were inherently autocratic, Britain's political framework was committed to minimal state interference. These liberal convictions reached a zenith in 1859 with the publication of John Stuart Mill's influential *On Liberty*, which warned of the dangers of excessive government and the erosion of individual freedoms. In the very same year, Britain addressed the question of pitch regulation, coinciding precisely with this broader context of political anxiety over state regulation. As the *diapason normal* was the direct product of Napoléon III's regime, attempting to emulate such musical order inherently involved questions of liberalism. Napoléon did appear something of an autocrat, maintaining a tight grip on the French state and dictating international policy. This was part of a centralizing tradition within French government, stretching back to at least Louis XIV's reign between 1643 and 1715. Just as Louis XIV had mobilized state musical performances for the celebration of his own personal power, uniting reverence for the monarchy with the cultivation of musical taste, Napoléon was eager to exhibit his authority through musical display.[9]

[8] We propose that pitch reform should be understood as a direct result of changes in musical taste during the nineteenth century. On these changes see, William Weber, *The Great Transformation of Musical Taste: Concert Programming from Haydn to Brahms* (Cambridge University Press: New York, 2008). See also, Christophe Charle, *La Dérégulation culturelle. Essai d'histoire des cultures en Europe*, (Presses Universitaires de France: Paris, 2015), pp. 263-312.

[9] The musical repertoire developed during his reign remained culturally influential throughout the eighteenth century. See, William Weber, 'La musique ancienne in the Waning of the Ancien Régime', *The Journal of Modern History*, Vol. 56, No. 1 (Mar., 1984), pp. 58-88; on Louis XIV and the use of the opera as political tool see, Olivia Bloechl, *Opera and the Political Imaginary in Old Regime France*, (University of Chicago Press: Chicago, 2017);

Although historians have debated the extent to which the Victorian British state can be described as *laissez-faire*, the introduction of national standards often raised questions over the role of government in society.[10] For example, the adoption of a national standard time was a lengthy process, in part because of local resistance to government interference. Although the Royal Observatory at Greenwich provided a daily time signal from 1833, and railways and telegraphy facilitated the spread of Greenwich time during the 1850s, it did not become Britain's legal time until 1880.[11] Similarly, when Parliament passed the Sale of Gas Act in 1859, attempting to protect consumers from fraud by defining a unified measurement of a cubic foot of gas, the Treasury attempted to prevent this legislation on the grounds that the government should not regulate markets.[12] Of all standards, that of musical pitch involved these political questions most directly. As the adoption of the *diapason normal* in 1859 was contingent on the ability of Napoléon's government to exert national regulation, British protagonists had to reconcile the autocratic nature of such a musical measure with their own liberal values. In contrast to French-style state intervention, the Society of Arts' pitch committee could, at best, recommend a unifying measure and hope that it would secure

and for his use of religious repertoires see, Thierry Favier, *Le Motet à grand choeur (1660–1792): Gloria in Gallia Deo*, (Fayard: Paris, 2009); on the structure and operation of Napoléon III's government see, Roger Price, *The French Second Empire: an anatomy of political power*, (Cambridge University Press: Cambridge, 2001), pp. 41-94.

[10] Although Victorian government was limited and cheap in comparison to its Continental rivals, Peter Baldwin has used the examples of taxation and public health to show that the British state was in many respects more effective than those in Europe, as argued in, Peter Baldwin, 'The Victorian state in comparative perspective', in Peter Mandler (ed.), *Liberty and Authority in Victorian Britain*, (Oxford University Press: Oxford, 2006), pp. 51-67; on the effectiveness of the Victorian state see, Philip Harling, 'The powers of the Victorian state', in Mandler (ed.), *Liberty and Authority in Victorian Britain*, pp. 25-50; Daunton shows that while the British state retreated from economic regulation, it remained active in maintaining competition by opposing protectionism within the market, such as in the gas, water, electricity, and telegraphy industries, as argued in, Martin Daunton, *State and Market in Victorian Britain*, (Boydell Press: Woodbridge, 2008), pp. 3-9; on market regulation also see, G. R. Searle, *Morality and the Market in Victorian Britain*, (Oxford University Press: Oxford, 1998); Anthony Howe, *Free Trade and Liberal England, 1846-1946*, (Oxford University Press: Oxford, 1998); Aashish Velkar, *Markets and measurements in nineteenth-century Britain*, (Cambridge University Press: Cambridge, 2012), pp. 25-7.

[11] David Rooney and James Nye, '"Greenwich Observatory Time for the public benefit": standard time and Victorian networks of regulation', *British Journal for the History of Science*, Vol. 42, No. 1, (Mar., 2009), pp. 5-30, 17-20; Iwan Rhys Morus, '"The nervous system of Britain": space, time and the electric telegraph in the Victorian age', *British Journal for the History of Science*, Vol. 33, No. 4, On Time: history, science and commemoration, (Dec., 2000), pp. 455-75, 469.

[12] Daunton, *State and Market in Victorian Britain*, pp. 119-20.

voluntary conformity. As *Chamber's Journal* put it, 'the French like to have things done for them by their government, even to the tuning of fiddles'.[13] In short, though intended to induce both national and international harmony, unifying pitch actually emphasized what made Britain different to France.

Throughout this article, it becomes clear that these political differences carried epistemological implications: they shaped contrasting bodies of knowledge on which to select a standard. After the French commission produced the *diapason normal*, which derived authority from the centralized imperial state, broader socio-political concerns informed British efforts to replicate this process. Amid tense Anglo-French diplomatic relations, British audiences interpreted the *diapason normal* as a measure of French autocracy. These politically liberal interpretations of the French standard materialized through the construction of a distinct epistemology of pitch, which resulted in a redefinition of the standard. The few vibrations setting the French and British pitches apart were an audible manifestation of political anxieties. These challenges of introducing a musical pitch within a liberal political framework were subsequently echoed in debates over the reform of weights and measures following the 1860 free trade treaty between Britain and France. By re-examining this broader issue of economic measures in light of musical pitch negotiations, we offer new insights on the entanglement of social and political values within processes of integrating standards. Recent histories have emphasized how musical and scientific knowledge was closely related during the nineteenth century, but this article demonstrates that these exchanges were also connected to broader international and political contexts.[14] Reconciling histories of science and music with political

[13] (Anon.), 'Tuning-forks and musical pitch', *Chamber's Journal of Popular Literature Science and Arts*, Vol. 34, No. 346, Jul.-Dec., 1860, (London, England), 18 Aug., 1860, pp. 98-101, 99.

[14] For example see, Alexander Hui, *The Psychophysical Ear: musical experimental sounds, 1840-1910*, (MIT Press: Cambridge, Massachusetts, 2013); Peter Pesic, *Music and the Making of Modern Science*, (MIT Press: Cambridge, Massachusetts, 2014); Alexandra Hui, Julia Kursell, and Myles W. Jackson, 'Sound, Music, and the Laboratory', *Osiris*, Vol. 28 (2013); Benjamin Steege, *Helmholtz and the modern listener*, (Cambridge University Press: Cambridge, 2012); James Q. Davies and Ellen Lockhart (eds.), *Sound Knowledge: music and science in London, 1789-1851*, (University of Chicago Press: Chicago, 2016); Myles Jackson has drawn attention to how, in nineteenth-century Germany, this relationship between music and science materialized through musical

and diplomatic studies, we illustrate how the investigation of standardization processes enriches our understanding of nineteenth-century Anglo-French socio-political culture.

The Emperor's New Pitch

When Jean-Jacques Rousseau observed in 1768 that since music had existed, it had never been played at the same pitch twice, he was in fact identifying a musical phenomenon that would become a growing concern throughout early nineteenth-century Europe.[15] While orchestras across the Continent had traditionally used different pitches, such variations became alarmingly apparent as musical cultures became more integrated. With the expansion of railways, the blossoming concert life of European cities relied to a large degree on the tours of foreign *virtuosi* and orchestras.[16] As travel infrastructure induced a rapid internationalization of the musical world, commentators increasingly observed the difficulties arising from the lack of uniformity in performing pitches. In the columns of the *Allgemeine musikalische Zeitung*, for instance, regular claims were made in favor of the adoption of a European standard pitch, to assist traveling musicians.[17] A congress held in Stuttgart in 1834 suggested a standard of A440, but this decision had very little impact in practice.[18]

In addition to these calls for pitch unification across geographical space, musical observers advocated the stabilization of pitch over time. It was a widespread belief that, since the late eighteenth century, pitches had become sharper; a phenomenon often attributed to the growing presence of brass instruments in orchestras and to solo violinists' attempts to seduce

standardization, see, Myles Jackson, *Harmonious Triads: physicists, musicians, and instrument makers in nineteenth-century Germany*, (MIT Press: Cambridge, Massachusetts, 2006), pp. 183-230.

[15] Jean-Jacques Rousseau, 'Ton', in *Dictionnaire de musique* (V^ve^ Duchesne : Paris, 1768), p. 516.

[16] Christian Meyer (ed.), *Le Musicien et ses voyages. Pratiques, réseaux et représentations*, (Berlin-Wissenschafts-Verlag: Berlin, 2002); Fulvia Morabito (ed.), *"En pèlerinage avec Liszt": Virtuosos, Repertoire and Performing Venues in 19th- Century Europe*, (Brepols: Turnhout, 2014).

[17] Jackson, *Harmonious Triads*, 199.

[18] Ibid., 206.

audiences with brighter musical sounds.[19] It became commonplace in the nineteenth century to regard notes tuned to a higher pitch as producing a brighter sound than the same notes played at a lower frequency. In part, these concerns were the product of 'the great transformation of musical taste' experienced in European musical networks: the persisting popularity of vocal works which Mozart, Gluck, Handel, and other celebrated masters had composed, were sometimes written for pitches much lower than the ones currently in use.[20] Many alleged these variations had dangerous consequences for singers, as they struggled to reach these higher pitches.

The first recorded state attempt to stop this escalation was made at the Paris Opera in 1801, quickly followed by the Conservatory's lowering of the institution's standard to protect the voices of its students from 'the disastrous excess' of high pitch in 1812.[21] Then, in 1824, following the complaints of the Paris Opera's *prima donna*, Madame Branchu, the minister of the *Maison du Roi* appointed a commission to fix a lower pitch at this venue.[22] This resulted only in a temporary solution to the problem: by 1840 the influential music critic François-Joseph Fétis denounced the 'murdering of singers' and requested the state act to protect vocalists from the threat of high pitches.[23]

In the context of the industrialization of instrument making, pitch standardization also drew attention from commercial interests. Following the Great Exhibition of 1851, international exhibitions offered a vivid picture of the internationalized integration of the

[19] Émile Leipp and Michèle Castellengo, 'Du diapason et de sa relativité', *Revue musicale*, No. 294 (1977), pp. 7-10.
[20] Weber, *The Great Transformation of Musical Taste.* On the pitches in use at the time of these composers see, Bruce Haynes, *A History of Performing Pitch: The Story of "A"*, (The Scarecrow Press: Lanham, Mar., and Oxford, 2002).
[21] Emmanuel Hervé, 'Le diapason de l'Opéra de Paris', *Musique. Images. Instruments*, Vol. 12 (2010), pp. 199-200 ; 'Institut impérial de France – Classe des beaux-arts. Séance publique du samedi 2 octobre 1813', in Jean-Michel Leniaud, *Procès-verbaux de l'Académie des beaux-arts* (École des Chartes: Paris, 12 vol, 2001-2018 [vol. 1, 2001]), p. 446.
[22] Hervé, 'Le diapason de l'Opéra de Paris', p. 200.
[23] 'Du changement de diapason que l'on dit projeté à l'Opéra', *Revue et gazette musicale de Paris*, Vol. 7, No 7 (January 23, 1840), p. 55.

musical instrument trade. The increased mechanization of labour enabled a more extensive production of artefacts, contributing to a rapid expansion of international exports.[24] Drawing inspiration from the 1855 *Exposition Universelle* in Paris, Jules-Antoine Lissajous (1822-1880), a young physicist who had just developed a method for visualizing sound vibrations, called for the organization of an international congress to stabilize and unify pitches throughout the world.[25] In front of the *Société d'Encouragement pour l'Industrie Nationale*, which Napoléon Bonaparte had established to enhance innovation through science, commerce, and banking, Lissajous made the case for a universal pitch.[26] Citing the precedent of the metric system, he emphasized the prestige that the French state could expect from adding yet another standard to its celebrated list of measures. Lissajous boasted how,

> France now possesses a complete and authentic collection of various measures. The care brought to the confrontation between the secondary standards with the prototypes stored at the archives, the means employed to control, continually, the exactitude of commercial and industrial measures, grant the indefinite conservation of this admirable system. It would be desirable that the same principles be applied to the establishment and the maintenance of pitch which serves, in some sort, as a sonic unit and for which there is no official standard up to today.[27]

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[24] Malou Haine, *Les Facteurs d'instruments de musique à Paris au XIX^e siècle: des artisans face à l'industrialisation* (Éditions de l'Université: Bruxelles, 1985).

[25] Steven Turner, 'Demonstrating Harmony: some of the many devices used to produce Lissajous Curves before the Oscilloscope', *Rittenhouse*, Vol. 11, No. 2 (1997), pp. 33-51.

[26] Serge Benoit, Daniel Blouin, Jean-Yves Dupont, and Gérard Emptoz**,** 'Chronique d'une invention: le *phonautographe* d'Édouard-Léon Scott de Martinville (1817-1879) et les cercles parisiens de la science et de la technique', *Documents pour l'histoire des techniques*, Vol. 17, No. 1 (2009), pp. 69-89; the text of his lecture was printed in the society's *Bulletin*. For this see, Lissajous, 'Note sur l'élévation progressive du diapason des orchestres depuis Louis XIV jusqu'à nos jours et sur la nécessité d'adopter un diapason normal et universel', *Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, Vol. 54, No. 2 (1855), pp. 293-297.

[27] 'La France possède aujourd'hui une collection complète et authentique des diverses mesures. Les soins apportés dans la confrontation des étalons secondaires avec les prototypes déposés aux archives, les moyens employés pour contrôler, sans cesse, l'exactitude des mesures commerciales et industrielles, assurent la conservation indéfinie de cet admirable système. Il serait à désirer que les mêmes principes fussent appliqués à l'établissement et au maintien du diapason qui sert, en quelques sorte, d'unité sonore et dont il n'existe aujourd'hui aucun étalon officiel.' Lissajous, 'Note sur l'élévation progressive du diapason des orchestres', p. 293.

The meter, which was claimed to be a division of the distance between the Earth's North Pole and Equator, did not just offer a precedent of a scientific measurement for music.[28] It also inspired Lissajous to propose a unifying pitch based on the decimal system. Although he recognized that musicians could well be the best judges of what such a pitch should sound like, the physicist suggested the standard of a B above-middle-C at 1,000 vibrations per second.[29]

Confirming the commercial significance such a standard would have, instrument makers gathered under the authority of the *Société des Fabricants de Pianos* in 1856 to discuss Lissajous' proposal.[30] Echoing the physicist's argument, the piano maker Henri Hoche expressed his wish that music rely on a 'natural' basis in the same fashion as the meter. Hoche explained that,

> In the same way science, at the beginning of this century, fixed the standard for metric measures, based on invariable elements taken from nature, isn't it logical that the musical art finds in an instrument given by the laws of physics a sonic standard with which everyone will want to conform and which will be transmitted from generation to generation?[31]

With the Emperor eager to support the cultivation of French musical practice and industry, Lissajous and the piano makers found a sympathetic ear. The nephew of Napoléon

[28] Calculated between 1792 and 1799, the metre was claimed to be one ten-millionth of a quadrant of the Earth's circumference. On the metric system, see Ken Alder, 'A Revolution in Measure: the political economy of the Metric System in France', in Wise, *The Values of Precision*, pp. 39-71, 52.
[29] Lissajous, 'Note sur l'élévation progressive du diapason des orchestres', p. 297.
[30] Reports on the instrument builders' meetings can be found in the following articles, Henri Hoche, 'De l'unité du diapason' *Le Luth français*, 5 June 1856, (Paris: France), p. 3; 'Société des fabricants de pianos. Procès verbal de la séance du 9 juin 1856. Présidence de M. Savart', ibid., 19 June, 1856, pp. 1-3; 'Correspondance', ibid., 5 July, 1856, pp. 5-6; Charles Delezenne, 'Correspondance', ibid., 20 July 1856, p. 6; 'Société des fabricants de pianos. Procès verbal de la séance du 4 août', ibid., 5 Sept., 1856, p. 1; 'Extrait du Procès-verbal de la Société syndicale des fabricants de pianos et autres instruments de musique', ibid., 5 Nov., 1856, p. 1.
[31] '[D]e même que la science, au commencement de ce siècle, a fixé l'étalon des mesures métriques, en prenant pour base des éléments invariables et puisés dans la nature même, n'est-il pas logique que l'art musical, à son tour, trouve dans un instrument donné par les lois de la physique un étalon sonore universel, auquel chacun voudra se conformer, et qui se transmettra d'âge en âge?', in Henri Hoche, 'De l'unité du diapason', p. 3.

Bonaparte, Napoléon III liberalized French theatres in 1864 to promote the nation's cultural life and was especially interested in conscripting music into state ceremonies.[32] In 1858, responding to the lobbying of instrument makers, the French Ministry of State appointed a commission charged with resolving the artistic and commercial difficulties raised by the heterogeneity of, and recent escalation in, musical pitch. Indicating the government's agreement with Lissajous and Hoche's conviction that the musical standard should be established on a scientific basis, the commission included Lissajous and César-Mansuète Despretz (1791-1863), a member of the *Académie des Sciences* and authority on thermodynamics. Celebrated opera composers otherwise dominated the inquiry, namely, Fromental Halévy (1799-1862), Daniel François Esprit Auber (1782-1871), Hector Berlioz (1803-1869), and Ambroise Thomas (1811-1896), all members of the *Académie des Beaux-Arts*. Finally, it included four representatives of the government, among which was General Émile Mellinet, as well as Édouard Monnais and Camille Doucet, respectively responsible for military bands and opera houses; these institutions were where the standard would most urgently have to be implemented.[33] Even though instrument builders had played a decisive part in securing the attention of the government, their role was minimal in the negotiations. Indeed, the commission's final report laid much of the blame for the escalation of pitch on manufacturers producing instruments capable of brighter sounds for commercial advantage. As the commission put it, this was because of the common perception that 'the higher the pitch, the brighter the sound'.[34]

Drawing on Lissajous and Hoche's universalist ambitions, the commission's report expressed a hope that France would lead the concert of nations in the standardization of pitch.

[32] Jean-Claude Yon (ed.), *Les Spectacles sous le Second Empire*, (Armand Colin: Paris, 2010).
[33] On military musical standards see, Simon Werrett, 'Disciplinary Culture: artillery, sound, and science in Woolwich, 1800-1850', *19th Century Music*, Vol. 39, No. 2, (2015), pp. 87-98.
[34] 'Plus le ton sera élevé, plus le son sera brillant.' *Rapport et Arrêtés pour l'établissement en France d'un diapason musical uniforme* (Imprimerie impériale: Paris, 1859), Archives nationales, F/21/768, p. 8.

As the report asked, 'Isn't it desirable, that a uniform and now fixed diapason adds to this intelligent community a supreme link and that an A, always the same, resonating on the whole surface of the universe with the same vibrations, eases the musical relationships, and makes them even more harmonious?'[35] These aspirations guided the commission's conduct; the subsequent report was grounded in the study of a broad spectrum of forks from across Europe.[36] Despite appearing to embrace scientific rationality, which was conceived of as an essential condition for the standard to secure international influence, the determination of the French pitch was not based on any measure of nature. The commission resolved on a standard of A870 (French acousticians counted each depression and elevation of an oscillation as a single vibration, so this measure equated to A435 in Britain, where a vibration was defined as a complete movement back and forth), corresponding to a quarter of a tone's reduction from the pitch in use at the Paris Opera.[37]

It was clear that, despite adopting precise measurement techniques involving the use of a siren, the commission was framing the problem of pitch in traditional musical terms.[38] Above all, however, this decision embodied a very different representation of nature to that on which the metric system was based. In a manner that echoed Rousseau's assertion that the singing voice was the primary musical expression of human emotion, the report claimed that,

> [t]he composer has in his head, in his imagination, one could say in his heart, the natural type of voices. A singer whom he himself hears, dictates to him the phrase he writes, and this singer always sings well. His voice, flexible, pure, intelligent, and just, is fixed by a true and moderate pitch which inhabits the ear

[35] Ibid., p. 12.
[36] Ibid., pp. 31-32.
[37] Along with different methods of counting vibrations, French and British inquiries into pitch differed in that while France took A as the note on which to establish a standard, in Britain acousticians talked in terms of a uniformed C.
[38] Charles Cagniard de la Tour's siren, developed in 1819, consisted of two disks, one of which oscillated to produce a measurable tone.

of the composer.[39]

In this way, instead of the dimensions of the Earth or mathematical theory, the commission identified the human voice as the ultimate reference for fixing a standard pitch. Echoing the concerns which the musical world had expressed regarding the dangers of high notes to vocalists, this statement designated the fixing of pitch within the purview of composers. Although this romanticized image depicted the composer's creative process as highly subjective, individual, and internal, it also embodied the socio-political structures of France's musical system, in which opera composers were the ultimate authorities. While the standard was presented as a compromise between the original diapasons of historic masterpieces and the sharper tones that military bands used, it represented a significant decrease in pitch from those the commission found in use across Europe.

Through the choice of such a low standard, the commission reaffirmed the superiority of traditional vocal repertoires over newer instrumental genres. A870 was a means of maintaining a musical order inherited from the *Ancien Régime,* which had crystallized through French vocal genres. In reference to the perceived escalation of pitch, the commission asserted that 'Religious music, dramatic music suffer the movement without being able to defend themselves from it, or trying to escape it'.[40] The commission's president, Halévy, was the author of several successful *grands operas,* the musical genre most closely associated with the representation of political power in nineteenth-century France.[41] In choosing A870, Halévy and his peers specifically intended to protect vocalists, who were the practitioners of this genre, from the assaults of new instrumental music. The state would be the guardian of this standard

[39] 'Le compositeur a dans sa tête, dans son imagination, on peut dire dans son cœur, le type naturel des voix. La phrase qu'il écrit lui est dictée par un chanteur que lui seul entend, et ce chanteur chante toujours bien. Sa voix, souple, pure, intelligente et juste est fixée d'après un diapason modéré et vrai, qui habite l'oreille du compositeur.' *Rapport et Arrêtés pour l'établissement en France d'un diapason musical uniforme,* p. 6.

[40] 'La musique religieuse, la musique dramatique ont subi le mouvement sans pouvoir s'en défendre ou sans chercher à s'y dérober', ibid., p. 10.

[41] Jane Fulcher, *The Nation's Image: French Grand Opera as Politics and Politicized Art*, (Cambridge University Press: Cambridge, 2002); also see, Mark Everist, 'The Music of Power: Parisian Opera and the Politics of Genre, 1806-1864', *Journal of the American Musicological Society*, Vol. 67, No. 3 (2014), pp. 687-736.

and, therefore, secure the grandeur of French music. In turn, French musical genres would ensure the nation's cultural influence at an international level.

The issue of an *arrêté* on 16th February 1859 fixed the *diapason normal* at A870 and ordered that 'all musical institutions … authorized by the State' adopt it.[42] In the same way that a standard meter had been deposited in the legislative chamber in 1799 as a reference for the metric system, a model of the *diapason normal* was stored at the Paris Conservatory.[43] To enforce this law, the government appointed Lissajous to control and validate the manufacture of all new diapason forks.[44] Beyond the walls of Paris's leading musical institutions, however, the standard remained largely unenforced. From the start, the *diapason normal* fell a long way short of creating a consensus. For example, Lissajous and Berlioz had warned that choosing a low standard would make its implementation difficult and instead recommended the adoption of the Opera's pitch of 1858, which would set the standard at A898.[45] In contrast, celebrated organ builder Aristide Cavaillé-Coll expressed a preference for an intermediary solution, with a pitch of A888, which he claimed would have the great advantage of conciliating 'the demands of the physical science and the needs of the musical art'.[46]

In addition to controversies over the frequency at which the commissioners had set the *diapason normal*, this new standard raised economic problems. Prophetically, the physicist Charles Delezenne warned in 1856 that 'when one will have adopted a pitch … one will have done nothing if they do not take the necessary measures to guarantee the conservation of this pitch and, above all, its identity in all French orchestras'. In the absence of effective

[42] *Rapport et Arrêtés pour l'établissement en France d'un diapason musical uniforme*, p. 33.
[43] See the correspondence between Jauniac, architect of the Conservatory and the ministry of Fine Arts held in Archives Nationales, F/21/768.
[44] Arrêté du 31 mai 1859 (Archives Nationales, AJ/37/81). On the manufacturing of normal forks in France after the decree of 1859, see David Pantalony, *Altered Sensations: Rudolph Koenig's Acoustical Workshop in Nineteenth-Century Paris* (Springer: Dordrecht, 2009).
[45] Lissajous, 'Note sur l'élévation progressive du diapason des orchestres', p. 297. Berlioz, 'Le diapason', *Journal des Débats*, 29 Sept., 1859, (Paris, France), p. 287.
[46] Aristide Cavaillé-Coll, 'De la détermination du ton normal ou du diapason pour l'accord des instruments de musique', *L'Ami de la religion et du Roi*, 5 Febr., 1859, (Paris, France): issue 6429, p. 313.

implementation, he feared that with a national standard, 'the harm will be multiplied by ten'.[47] By 1859, this prediction appeared vindicated and instead of a single unified measure, France had merely gained 'yet one more pitch'.[48]

While the state did not provide public musical institutions with the financial means to enforce the *diapason normal*, provincial actors, be they musicians, theatre administrators, or town mayors, often refused to pay for the change of instruments necessary for the implementation of the new standard. In 1862, for instance, the *Préfet du Nord* reported to the government that in the Northern cities of Dunkerque and Valenciennes, orchestras were still using the same instruments and standard as before the 1859 decree.[49] The same year, the Mayor of Douai complained of his financial struggles to the government, explaining that instrument builders were taking advantage of the situation to make a quick profit by selling brand-new instruments instead of simply adjusting the ones previously in use.[50] In other words, as idealistic and intellectually satisfying as it may have appeared at the time, the *diapason normal* was impractical and its domestic implementation troublesome.

If the adoption of the French standard was a challenge on a national level, it was even more so on the international stage. As the French pitch was imbued with the musical and socio-political structures of the country, it lacked the universality that its earliest promoters had envisioned. The question then was, if it was difficult to introduce this essentially Parisian standard in French provinces, how could it travel beyond France to foreign musical communities? If the French state failed to set a standard for musical taste on its own territory, how could it hope to export this measure abroad? Yet for all its shortcomings, the measure

[47] 'Quand on aura adopté un diapason […], on n'aura rien fait si l'on ne prend pas des mesures pour assurer la conservation de ce diapason et surtout son identité dans tous les orchestres de France'. The physicist also predicted that 'Le mal auquel on aura voulu porter remède sera décuplé.' 'Correspondance [Letter from Charles Delezenne to Adolphe Giacomelli]', *Le Luth français*, 5 July, (Paris, France), 1856, p. 5.
[48] Johannes Weber, 'Critique musicale', *Le Temps*, 14 July, 1863, (Paris, France), p. 2.
[49] Letter from the prefect of the North to the minister of State, March 28, 1862 (Archives Nationales, F/21/1238).
[50] Letter from the mayor of Douai to Camille Doucet, chief of the Theaters' office at the Ministry of State, 17 Sept. 1862, (Archives Nationales, F/21/1203).

nonetheless attracted considerable attention and had some valuable characteristics. Although not 'scientific' in the same sense as the metric system, the French pitch still had the advantage of anteriority, due to the centralization of the state and Napoléon's autocratic manner of government. It was precisely these two political qualities which at once aroused the attention of, and drew criticisms from, France's neighbours in Britain.

The Measure of Anglo-French Relations

France's efforts to standardize musical pitch did not go unnoticed in Britain. On learning in August 1858 that Napoléon had established a commission to determine a 'uniform diapason', *The Spectator* hoped that Britain would soon follow this act of 'perfect national unity'. Blaming individualistic composers, instrumentalists, and vocalists for raising pitch in an attempt to produce increasingly 'brilliant' musical performances, the politically radical and reforming journal was confident that the only way to prevent further escalation was for the government to take action.[51] *The Spectator* asserted that of 'all the nations of the earth … the French perhaps are the very best to assist us in this particular search', having been the first to systematically base their weights and measures 'upon a natural standard'.[52] The only solution appeared to be to 'obtain a scientific, physical standard of pitch' and then for all musical practitioners to 'agree universally to be governed by it'.[53]

Yet *The Spectator's* approval of French efforts to uniform musical pitch was in fact highly political. This was not just a comment on how to regulate an art, but a vindication of Napoléon's entire system of government. For *The Spectator*, Napoléon 'was the motive brain' of the Second Empire. Ordering musical pitch through state apparatus therefore had social and economic implications. If musicians could not be trusted to regulate their instruments on an

[51] (Anon.), 'An Imperial Pitchfork', *The Spectator*, 28 Aug., 1858, (London, England), pp. 910-11.
[52] Ibid., pp. 910-11.
[53] (Anon.), 'Pitch Reform in France and England', *The Spectator*, 12 Mar., 1859, (London, England), p. 290.

individual basis and required government intervention, then this principle might well be extended to the rest of society. *The Spectator* argued that the escalation of pitch offered broader lessons on the dangers of a *laissez-faire* state: liberal governance of the arts resulted in 'musical anarchy'. Without the authority of 'a gracious Emperor, strengthened by a sufficient reverence for music', like Napoléon, the journal was sure that the art would descend further into disorder.[54]

The suggestion that the governance of Napoléon was something to emulate was a controversial one. Although *The Spectator* praised the politics of pitch making in France, the autocratic connotations of Napoleonic governance made any attempt to follow French-style legislation for standardization a difficult enterprise, inseparable from the broader political context of the late 1850s. As Jonathan Parry has argued, mid-Victorian British political culture was often defined in terms of comparison with France. British commentators took satisfaction on having avoided the political upheavals of 1789, 1799, 1830, 1848, and 1851, attributing Britain's relative political stability to a system in which monarchy was accountable to a parliament, protective of individual liberties and religious toleration, and watchful of high taxes and military expansion.[55] Britain's upper and middle classes prided themselves on their liberal system of government, in which the economy was thought better regulated by natural laws and *laissez-faire* thinking, than by any legislation a parliament might be capable of conceiving.[56] In this respect, France served as the antithesis of how British audiences defined themselves. The Conservative-inclined *The Times* regarded Napoléon's use of referenda to secure approval for his regime between 1851 and 1852 as nearing outright socialism; these popular votes were

[54] (Anon.), 'An Imperial Pitchfork', *The Spectator*, 28 Aug., 1858, (London, England), pp. 910-11.
[55] J. P. Parry, 'The impact of Napoleon III on British politics, 1851-1880', *Transactions of the Royal Historical Society*, Vol. 11, (2001), pp. 147-75, 150-1.
[56] On the limited extent of *laissez-faire* government, see Mandler, 'Introduction: state and society in Victorian Britain', in Mandler (ed.), *Liberty and Authority in Victorian Britain*, pp. 1-21, 1-2; Daunton, *State and Market in Victorian Britain*, pp. 4-5; Boyd Hilton, 'Moral Disciplines', in Mandler (ed.), *Liberty and Authority in Victorian Britain*, pp. 224-46, 225; J. P. Parry, 'Liberalism and Liberty', in Mandler (ed.), *Liberty and Authority in Victorian Britain*, pp. 71-100, 71.

compared to mob rule, in direct contrast to the free liberal criticism that set Britain apart.[57] For politicians like Viscount Palmerston (1784-1865), who had dominated British foreign policy for over three decades first as Foreign Secretary and then as Prime Minister, defining 'Britishness' was easiest in terms of what France was not.[58] So for *The Spectator* to celebrate the state regulation of music by an imperial decree as the act of a 'gracious Emperor' was certainly a radical statement.

French politics also informed British understandings of new musical practices. Establishing systems intended to discipline musicians in nineteenth-century Britain was often challenging. For example, while common on the Continent, British musicians were particularly resistant to the introduction of orchestral conducting. In 1820 the celebrated composer Louis Spohr alarmed the governors of the London Philharmonic by wielding a baton to lead the orchestra, a practice that had emerged in response to the challenge of directing ensembles of increasing size. British musicians preferred the traditional custom of using the ear to follow the lead of a first violinist or piano. In contrast to this, conductors appeared to British audiences as subversive dictatorial figures, comparable to Bonaparte. Under the direction of such autocrats, musicians feared they would lose their individual authority to the European trend towards 'despotism in musical governments'.[59] British orchestras took several decades to fully embrace conductors. Interpretations of new practices for regulating musical performances were shaped by liberal notions of freedom and individualism.

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[57] Parry, 'The impact of Napoleon III on British politics, 1851-1880', p. 154; also see, Georgios Varouxakis, *Victorian Political Thought on France and the French*, (Palgrave: Basingstoke, 2002); on *The Times* see, Laurence Fenton, *Palmerston and The Times: foreign policy, the press and public opinion in mid-Victorian Britain*, (I. B. Tauris: London, 2013), pp. 125-43.

[58] David Brown, 'Palmerston and Anglo-French relations, 1846-1865', in Glyn Stone and T. G. Otte (eds.), *Anglo-French relations since the late eighteenth century*, (Routledge: London, 2008), pp. 41-58, 42.

[59] Alison Winter, *Mesmerized: powers of mind in Victorian Britain*, (University of Chicago Press: Chicago, 1998), pp. 310-1; Fiona M. Palmer, *Conductors in Britain, 1870-1914: wielding the baton at the height of empire*, (The Boydell Press: Woodbridge, 2017), pp. 13-5; on the place of music and the individual within Victorian liberal thought see, Sarah Collins, 'Aesthetic Liberalism', in Sarah Collins (ed.), *Music and Victorian Liberalism: composing the Liberal subject*, (Cambridge University Press: Cambridge, 2019), pp. 1-12, 11; also see, Erin Johnson-Williams, 'Musical Discipline and Victorian Liberal Reform', in Collins (ed.), *Music and Victorian Liberalism*, pp. 15-36.

Despite these perceived political differences, Britain and France were not inherently opposed during the 1850s. Napoléon's election as president in 1848, dissolution of the French National Assembly following the *coup* of December 1851, and self-appointment as Emperor on the anniversary of Austerlitz in 1852, provoked concern with British audiences that the new French autocrat was intent on emulating the ambitions of his militaristic uncle.[60] Nevertheless, John Russell's (1792-1878) Whig administration was reassured that the French government would now be in the hands of moderates who respected private property and the rule of law, rather than unpredictable revolutionaries.[61] Palmerston believed that the new Emperor brought order to a nation characterized by political instability.[62] Internationally, the two nations often found common ground, going to war together against Russia in the Crimea (1854-1856) and then against China (1859-1860). As David Todd has emphasized, although Britain and France were certainly rivals, this period was notable for the fact that the two nations were not at war.[63]

Despite this, France established the *diapason normal* at a moment when Anglo-French relations were profoundly strained. Throughout the 1850s there were several invasion panics in Britain, arguably the greatest of which lasted from 1858 until 1859 – coinciding exactly with the French commission on standardizing musical pitch. Relations deteriorated following Italian revolutionary Felice Orsini's failed assassination attempt on Napoléon in January 1858. When it turned out that this had probably been planned in London and that the bomb had been made in Britain, Palmerston tried to preserve Anglo-French relations by introducing a Conspiracy to Murder Bill in Parliament. Fearing that this act amounted to France dictating

[60] Brown, 'Palmerston and Anglo-French relations, 1846-1865', in Stone and Otte (eds.), *Anglo-French relations since the late eighteenth century*, pp. 45-6.
[61] David Brown, 'Palmerston and Anglo-French relations, 1846-1865', *Diplomacy and Statecraft*, 17:4, (2006), pp. 675-92, 679.
[62] Palmerston was dismissed from office in 1851 for prematurely endorsing Napoléon's *coup*, as explored in, Brown, 'Palmerston and Anglo-French relations, 1846-1865', *Diplomacy and Statecraft*, p. 680.
[63] David Todd, 'A French Imperial Meridian, 1814-1870', *Past and Present*, No. 210, (2011), pp. 155-86, 162; on imperialism see, David Cannadine, *Victorious Century: the United Kingdom, 1800-1906*, (Allen Lane: London, 2017), pp. 302-18; in 1858 Conservative Chancellor Benjamin Disraeli (1804-1881), with typical fanfare, summed this up by announcing that Anglo-French cooperation was 'the key and corner-stone of modern civilization', quoted in, Parry, 'The impact of Napoleon III on British politics, 1851-1880', p. 149.

reforms to the English legal system, MPs rejected the measure and Palmerston was forced to resign.[64] At the same time, the French development of a large naval base at Cherbourg and construction of the first ironclad warship, the *Gloire*, fuelled fears that Napoléon intended to challenge British naval dominance. In August 1858 the Earl of Derby (1799-1869), the Conservative Prime Minister, summed up this hysteria, observing that 'what a store of powder they have in hand! Enough for six Crimean Wars!'[65] Even Derby's Foreign Secretary, the Earl of Malmesbury (1807-1889), a friend and supporter of Napoléon since 1829, found French naval expansion troubling, as did Queen Victoria.[66] In response, both Conservative and Liberal governments increased defence spending, fortifying dockyards across England's south coast.

The Second Empire's standardization therefore took place at a moment when Britain regarded the French state with immense suspicion. Yet while politicians took precautionary measures in fear of an invasion and prepared for conflict, Britain's musical and scientific elites considered how to respond to the *diapason normal*. Nevertheless, the strained relations between France and Britain shaped subsequent efforts to disseminate an international musical standard. Within the context of political and military tension, replicating the French standard presented a unique challenge: how could musicians, composers, and instrument makers be regulated in the same fashion as those within a state which was persistently construed to be both autocratic and militaristically aggressive? Such values were at complete odds with those of liberal Victorian society.

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[64] Brown, 'Palmerston and Anglo-French relations, 1846-1865', in Stone and Otte (eds.), *Anglo-French relations since the late eighteenth century*, p. 50.

[65] Quoted in, Geoffrey Hicks, 'The struggle for stability: the fourteenth earl and Europe, 1852-1868', in Geoffrey Hicks (ed.), *Conservatism and British Foreign Policy, 1820-1920: the Derbys and their world*, (Ashgate: Farnham, 2011), pp. 81-98, 91.

[66] Geoffrey Hicks, 'An overlooked Entente: Lord Malmesbury, Anglo-French relations and the Conservative's recognition of the Second Empire, 1852', *History*, Vol. 92, Iss. 306 (Apr., 2007), pp. 187-206, 201; Brown, 'Palmerston and Anglo-French relations, 1846-1865', in Stone and Otte (eds.), *Anglo-French relations since the late eighteenth century*, p. 49; also see, C. I. Hamilton, *Anglo-French Naval Rivalry, 1840-1870*, (Clarendon Press: Oxford, 1993). The subsequent French annexation of Savoy and Nice in 1860 confirmed Victorian notions of Napoléon as a militaristic despot.

A Liberal Pitch

In London it was Harry Chester (1806-1868), a promoter of several scientific institutions and Vice-President of the Society of Arts, who was perhaps most enamoured by the French standardization of pitch. Eager to follow the example of the *diapason normal* but, at the same time, deeply troubled at the political implications of making such a measure law, Chester encouraged Charles Wentworth Dilke (1810-1869), chairman of the Society of Arts' Council, to take up the matter. Chester immediately explained that although it may be worth considering a similar standard in Britain, it could not be implemented through the same procedures as it had been in France. Expressing this dilemma, he informed Dilke that,

> in the absence of any competent musical authority legally or officially established in England, the Society of Arts might convene a conference of musical magnates, amateurs as well as professionals, composers, instrument-makers, vocalists, and instrumentalists, to discuss the subject, and to determine whether the society should frame a resolution, and get it extensively signed: to the effect that the persons signing accepted the French decision, and would use their influence to procure the adoption of the same uniform pitch. By such a measure, we might make what would be equivalent to a voluntary law for ourselves; and public opinion, thus expressed, would lead the instrument-makers generally to confine themselves to that standard.[67]

The solution here proposed was for the Society of Arts to initiate the inquiry, but that instead of being implemented through state legislation, as the *diapason normal* had been, the British standard would be adopted in reference to public consultation and agreement. It was intended, in this way, to be a model of how to unify a measurement within a liberal political framework.

[67] (Anon.), 'Tuning-forks and musical pitch', *Chamber's Journal of Popular Literature Science and Arts*, Vol. 34, No. 346, Jul.-Dec., 1860, (London, England), 18 Aug., 1860, pp. 98-101, 100-1.

Yet the very nature of manufacturing this consensus would ultimately change the character of the standard itself and result in something quite different from the *diapason normal*. Pitch in this way offers a striking example of how social and political compromises could be central to nineteenth-century processes of enforcing scientific and technological standards.

Following up on Chester's suggestion, in May 1859, Dilke reported to the council of the Society of Arts that France had recently agreed on a standard musical pitch and that he 'had consulted with many leading musical authorities in this country as to the practicality of effecting the same object in this country'.[68] The Society's council summoned a preliminary meeting of scientific and musical men on 3rd June to discuss 'how far it would be practicable to do anything in this country in reference to it' and whether 'it was desirable that one Uniform Musical Pitch should prevail'.[69] Agreeing on the advantages of establishing a musical standard, the council appointed a committee charged with addressing this question. Such musical regulation was consistent with the Society of Arts' broader remit. Founded in 1754 to encourage the nation's arts, manufactures, and commerce, the Society of Arts had campaigned for reforms of Britain's weights and measures since 1851.[70] As well as supporting the adoption of the metric system, the Society was eager to promote a uniform system of education.[71]

The committee appointed to investigate standard pitch included mathematicians, musical performers, composers, instrument makers, and natural philosophers. With the lawyer Thomas Philipps as chairman, William Whewell, Augustus de Morgan, Henry Wylde, Charles Wheatstone, and Robert Willis offered scientific expertise, while musical representatives included Sterndale Bennett, Henry Griesbach, Henry Lunn, and George Smart. There were also celebrated instrument makers, such as Walter Broadwood and Henry Willis. This combination

[68] Royal Society of Arts (hereafter RSA), AD/MA/100/12/02/11. *Minutes of the Council*, 122 (May 11th, 1859).
[69] Ibid., May 25th, 1859; ibid., June 1st, 1859.
[70] Edward Franklin Cox. 'The Metric System: A Quarter-Century of Acceptance (1851-1876)', *Osiris* 13 (1958): 358-79, 365; the Society of Arts received a Royal Charter in 1847 and became the Royal Society of Arts in 1908.
[71] Derek Hudson and Kenneth W. Luckhurst, *The Royal Society of Arts 1754-1954* (London: John Murray, 1954).

of mathematical and musical knowledge certainly satisfied *The Spectator* which reported that the inquiry included 'representatives of mathematical science, concert conductors, pianoforte-makers, composers, the teacher of the rising public, and the prince of opera conductors'.[72] Despite this, the journal was disappointed that the Society of Arts intended to establish a new standard rather than adopting the *diapason normal*. It was to be regretted that the committee did not simply endorse the French pitch, but instead raised the possibility of deviating from this standard. *The Spectator* asserted that the Society should promote integration, believing that 'the most desirable spirit for a new committee would be one of cordial cooperation with the French Government. Our committee may be superior in its representatives of mathematics, but none of its members will be inclined to look with disrespect upon a Commission which comprises an Auber, a Berlioz, a Halévy, or a Rossini'.[73]

The Spectator was astute in identifying the national differences in approaching pitch reform, as well as in acknowledging how deeply embedded the French commission had been in its opera-dominated musical culture. However, with its strong tradition of Handelian oratorios and church choral music, as well as a national penchant for Italian opera, the British shared the same cultural concerns that the recent escalation of pitch was detrimental to the voices of singers and risked the survival of past musical works. But the British committee was determined to secure its standard scientific credibility, asserting that a 'sound is not merely more acute or grave, in relation to another; its pitch is capable of exact measurement, and that measurement once recorded, it may be reproduced at any distance of time'.[74] The committee was convinced that 'Physical science is, happily, enabled to afford this, and to bring to the aid

[72] (Anon), 'English committee on musical pitch', *The Spectator*, 18th June 1859, pp. 639-640, 639. It is probable that the 'teacher of the rising public' referred to John Hullah and the 'prince of opera conductors' to George Smart, conductor at Covent Garden.
[73] Ibid..
[74] 'Uniform musical pitch. Minutes of a meeting of musicians, amateurs, and others interested in music, held at the house of the society of arts, when the report of the committee appointed by the council of the society was received and adopted', *The Journal of the Society of Arts* 8, no. 417 (1860), pp. 1-8, 3.

of musical art more than one process by which such a standard may be adjusted'.[75] By placing a greater emphasis on mathematics, the committee was trying to produce a standard invested with scientific authority. As the Society of Arts lacked legislative power, the members of this body laboured to secure approval from Britain's musical communities. Chester advised the committee that they 'could not in this country make a law for a compulsory uniform pitch, as had been done in a neighbouring state', but he remained hopeful that Britain would 'obtain the same good practical results'.[76]

These political anxieties over the role of the state gave shape to a new epistemology of pitch. While in France, the committee consulted an international selection of tuning forks, the British conducted a national surveying of attitudes towards the musical standard. In a sense, this reflected cultural differences between London and Paris. While the Paris-based French commission attempted to impose a musical standard on the rest of the country, London's Society of Arts sought to secure a national consensus, taking into account provincial concerns in a manner that was consistent with the prominence of local government within British politics. On 28th August 1859, the committee sent letters to the leading musical societies and institutions across the British Isles, inquiring as to if a national standard was desirable, if it would be difficult to introduce, and at what level it should be set. This was not only an effort to secure national consent but was intended to fulfill a very different ambition to that which the French inquiry had pursued. The tuning forks that the French consulted were not necessarily indicative of musical practice; often individual institutions sent forks to the commission which were misleadingly portrayed to be representative of entire cities or regions.[77] In contrast, the British were trying to secure knowledge of actual musical practices.

[75] Ibid., p. 3.
[76] Ibid..
[77] *Rapport et Arrêtés pour l'établissement en France d'un diapason musical uniforme*, p. 31 ('Tableau des diapasons usités dans les principales villes de France et d'Europe, d'après les types reçus par le Ministère d'État').

From the survey, a general consensus emerged that there should indeed be a national standard of pitch. The committee found that organ builders, piano makers, and manufacturers of wind and brass instruments were especially supportive of such regulation. Recalling previous disagreements between vocalists and instrumentalists in France, there were competing claims of what this standard should be. While the committee uncovered 'a decided feeling, especially among violinists, in favor of a high pitch, as contributing to "increased brilliancy" in the *timbre* of the instrument', there was evidence from singers around the country that vocalists were struggling with pitch increases.[78]

Confirming fears that escalating pitch presented a physiological risk to the wellbeing of vocalists, W. Mason, conductor of Lincoln Cathedral's choir, reported that, during his twelve years of teaching singers, he had observed 'that three voices out of four are either broke or ruined before they are developed in consequence of the high pitch'.[79] W. Lockyer echoed this sentiment, hoping that the committee would establish a pitch that was 'attainable to the powers of the human voice', while Charles Saldman believed 'the fact to be almost unanimously acknowledged, that the musical pitch, most in use in this & in other countries, is inconveniently high … because it fatigues & strains voices'.[80]

It was not just the physiological threat to the voice that Saldman drew attention to. He also argued that pitch should be lowered to preserve the integrity of historical works, explaining that pitch escalation gave 'a different character to musical compositions which were produced when the pitch was at least a half tone lower'.[81] There were ramifications for religious practice too. E. G. Monk, Organist of York Minster claimed to have used a tuning fork of C512 in his role as director of the Minster's choir and testified that this was 'a very satisfactorily pitch;

[78] Herschel, 'Uniform musical pitch'.
[79] RSA/PR/GE/121/10/5, letter from W. Watson to Peter le Neve Foster, Lincoln, 6 Sept., 1859.
[80] RSA PR/GE/121/10/5, letter from W. Lockyer to Foster, 10 Sep., 1859'; RSA PR/GE/121/10/5, Musical Pitch, Charles Saldman to Foster, London, 10 Sept., 1859.
[81] RSA PR/GE/121/10/5, Musical Pitch, Charles Saldman to Foster, London, 10 Sept., 1859.

possessing a good medium between the extremes of the opera standard, & the church organ low pitch so unhappily persistent. The latter, it may be asserted, is extremely inconvenient for the very purposes it ought best to serve: viz., for cathedral music'.[82] Together, these replies to the committee's survey identified a broad range of problems resulting from the dramatic increase of pitch within Britain's musical communities. Nevertheless, several of the respondents expressed their doubts that the committee had the power to enforce any regulation. E. Shepherd for example, the honorary secretary of Abingdon Musical Association, wanted pitch to be reduced but could not see 'how this can be met except by an act of parliament'.[83]

From this survey it was clear that there was support for a unified pitch. The difficulty was in determining the number of vibrations to which the standard should be set, which meant arbitrating between competing claims from musical practitioners. Like the French commission, the committee prioritized the experiences of vocalists and agreed to protect the voice from the perceived damages of escalating pitch. Both the Stuttgart pitch of A440 (C528) and the *diapason normal* of A435 (C522) provided lower alternatives to the pitch in present use at London's Italian Opera, C546, but the project of producing a liberal pitch involved mobilizing alternate forms of authority to those of the state. As a result there was interest for selecting a pitch with scientific credentials. With Whewell, Wheatstone, de Morgan, and William Pole as members, the committee included leading representatives from the British scientific community. At the first meeting of the pitch committee a letter from the celebrated astronomer John Herschel, addressed to the committee's chairman, was read making the case for a pitch grounded in mathematical theory.

Herschel's argument, which was subsequently published in the *Leeds Mercury*, was that a standard C should be fixed at 512 vibrations. This was grounded in the mathematical

[82] RSA/PR/GE/121/10/5, letter from E. G. Monk to Foster, 2 Jun., 1859.
[83] RSA/PR/GE/121/10/5, letter from E. Shepherd to Foster, Abingdon, 8 Sept., 1859.

theory that the various octaves of a note corresponding to one vibration per second consisted of a series of powers to the number of 2. Based on this mathematical principle, C512 would be the ninth octave of a fundamental note corresponding to one vibration per second. Herschel contended that this had

> a claim to universal reception on the score of intrinsic simplicity, convenience of memory, and reference to a natural unit, so strong that I am amazed at the French not having been the foremost to recognize and adopt it, when it is remembered that their boasted unit of length, the meter, is based on the subdivisions of a natural unit of space, just as the second (a universally used aliquot of the day) is of time; the one on the linear dimensions, the other on the time of rotation of the earth.[84]

Emphatically, Herschel asserted that in this matter he was 'more French than the French themselves' and implored the committee to 'act once for all; to adopt the C of 512 vibrations, and so to carry out this as part and parcel of a complete natural metrical system, which would recommend itself to all nations on its own merits'.[85]

The committee placed considerable weight on Herschel's intervention. After all, in mid-Victorian Britain, there were few who wielded as much influence over matters scientific. The son of the musician and astronomer William Herschel, John Herschel's cataloguing of stars meant that by the 1840s he was arguably the most eminent scientific authority in the country. Reviewing Herschel's proposal of C512, the committee felt that this mathematical ideal carried a great deal of credibility: it was a pleasing 'theoretical pitch'.[86] Although they were not trying to compete with the *diapason normal*, the committee felt that in invoking mathematical knowledge, they were completing France's project for standardizing music.

[84] Herschel, 'Uniform musical pitch'.
[85] Ibid..
[86] 'Uniform musical pitch', *The Journal of the Society of Arts*, p. 4.

Adopting C512 would not constitute an outright rejection of the French pitch, as the committee explained how the 'commission recently appointed to report on the pitch in France, who appeared to have been governed by considerations of a purely practical kind (therefore ignoring mathematical convenience entirely), have decided on a pitch, certainly not identical with the pitch 512 vibrations, but differing from it only to the extent of ten vibrations per second'.[87] Herschel's proposal represented only a minor corrective to the French standard.

Nevertheless, the committee felt that C512, while theoretically authoritative, would be practically impossible to impose. With several orchestras using a pitch of C546, a sudden reduction to C512 'could not be made without great inconvenience and pecuniary lost to the body with whom the adjustment of the pitch practically rests', namely musicians, musical institutions, and instruments makers.[88] This acknowledgement that the acceptance of any standard pitch was contingent on the musical community represented a dilemma. On the one hand, the committee wanted to utilize science to invest credibility in to their standard pitch but, at the same time, such a standard could not secure consensus in society. What was required was a compromise. While the French arbitrated between different musical traditions, the British decided on C528, a rough average of C512 and C546. The measure was positioned half way between mathematical knowledge and contemporary musical practice. The committee thus acknowledged its limited ability to introduce a natural standard. This was made clear when information reached the committee of 'considerable difficulties … in enforcing the new musical diapason in France, and that authority such as would never be sought for, or obtained, in this country, has found a powerful antagonism in "the inexorable logic of facts."'[89]

On 5th June 1860 the committee presented its report to a public meeting at the Society of Arts, proposing C528 as a national standard. Committee member G. T. Driffield reassured

[87] Ibid., p. 5.
[88] Ibid., p. 5.
[89] Ibid., p. 5.

the audience 'that in the report there was not attempt to dictate to the meeting, or to the musical public generally', making it clear that this was intended to be voluntarily adopted. However, within the audience was Herschel, who made a final claim for C512. Emphasizing the value of mathematical knowledge, Herschel specified that it was 'his desire that some general and correct principle, easy of application to this subject should be recognized, which he thought would place them in a position superior to their French neighbours under compulsory legislation'.[90] Despite this, Herschel's revision found little support. Committee members F. Davison, John Hullah, and Chester were convinced that Britain's musical communities would never accept C512. When Herschel suggested adopting C528 while simultaneously acknowledging the scientific authority of C512, Hullah was adamant that such ambiguity would fail to achieve national unity. As he put it, if 'that meeting were a parliament, and could force the country to adopt this view, the case would be different. After all, they merely passed a resolution; and to go before the world with a resolution upon which they were unresolved would stultify their proceedings entirely'.[91] Rejecting Herschel's advice, the meeting therefore agreed to recommend C528.

Over the next decade it would become clear just how little impact this measure had on British musical practice. Nine years after the committee recommended C528, Henry Lunn, a member of the Society of Arts' investigation, reported in the *Musical Times* that pitch was still not uniformed. He argued that unless the French standard was introduced nationally, Britain would remain in a state of musical chaos.[92] Indeed, without regulation, the frequency at which Britain's premier musical institutions set their pitch continued to escalate. At the Wagner Festival of 1877, held in the Royal Albert Hall, Continental vocalists complained at being asked to sing to a pitch of A455, while the celebrated Italian-French soprano Adelina Patti (1843-

[90] Ibid., p. 6.
[91] Ibid., p. 8.
[92] Henry C. Lunn, 'Musical Pitch', *The Musical Times, and Singing Class Circular*, Vol. 13, No. 312, (1 Feb., 1869), pp. 663-5.

1919) refused to sing at Covent Garden in 1879, asserting that the orchestra's A455 was too high.[93] It would be a long time before Britain agreed to enforce a standard musical pitch. A second Society of Arts' committee failed at securing the adoption of the French standard in 1886, and Britain only came to agree with the rest of Europe and the United States in 1939, during an international congress held in Broadcasting House in London.[94] By then, Victorian preoccupations with liberalism and minimal government interference had been swept away through the reforms of the growing welfare state.

The Measure of a Nation

Acknowledging the diversity of opinions expressed within the national survey, the Society of Arts' standard pitch was deeply invested with political values. But the problem of manufacturing a liberal standard was equally pertinent in discussions over the introduction of measures beyond those musical. During the late 1850s and early 1860s there was a considerable effort to bring France and Britain together through economic and social regulation. By examining these broader attempts to integrate the two economies, it becomes apparent that the question of musical standardization was in fact part of a much larger cultural exchange in which both nations sought to reorder society and forge a stronger relationship with each other. But, as with musical pitch, these attempts at social-economic integration in fact emphasized the differences between France and Britain.

When Palmerston returned to power in June 1859, just a month before the *diapason normal* became France's standard pitch, his administration's priority was to enhance national defence, but he was also eager to improve relations with Napoléon. For his part, the Emperor was keen to build friendship with Britain to ensure that Austria and Prussia would not form an

[93] Haynes, *History of Performing Pitch*, pp. 356-7.
[94] G. W. C. Kaye, 'International Standard of Concert Pitch', *Nature*, 27 May 1939 (London, England); issue 3630, pp. 905-906.

alliance and interrupt his plans to promote Italian nationalism.[95] So when, that same summer, the French political economist Michel Chevalier (1806-1879) wrote to the radical MP for Rochdale, Richard Cobden (1804-1865), proposing a free trade treaty between their nations, there was mutual support for such a project.[96] An ardent critic of protectionism, Chevalier promoted increased integration between Britain and France, including the construction of a railway from London to Paris.[97] Cobden responded to Chevalier's suggested treaty by observing that Britain required no increase of trade, having 'as much to do as we can accomplish' and asserting that it was already difficult to manage 'the working classes owing to the great demand for their labour'.[98] However, Cobden agreed that a free trade agreement was the only hope 'for any permanent improvement in the political relations of France & England'.[99] Bringing each nation 'into mutual dependence by the supply of each others wants' was, Cobden alleged, 'God's own method of producing an *entente cordiale*'.[100] Integrating economies was a vastly superior way to maintaining peace than military collaboration; as Cobden reflected, what was the 'value of an alliance in China or any other pretended *entente cordiale* whilst we were keeping up 26 millions of armaments principally as a defence against France'.[101] Free trade and economic integration were Cobden and Chevalier's solution to international tensions.

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[95] A. A. Iliasu, 'The Cobden-Chevalier commercial treaty of 1860', *Historical Journal*, Vol. 14, No. 1 (1971), pp. 67-98, 72-4; on the Italian question see, William E. Echard, *Napoleon III and the Concert of Europe*, (Louisiana State University Press: Baton Rouge, 1983), pp. 107-28.
[96] Nicholas C. Edsall, *Richard Cobden: independent radical*, (Harvard University Press: Massachusetts, 1986), pp. 330-1; also see, Arthur Louis Dunham, *The Anglo-French Treaty of Commerce of 1860 and the progress of the industrial revolution in France*, (University of Michigan Press: Ann Arbor, 1930).
[97] Todd, 'A French Imperial Meridian, 1814-1870', pp. 175-8; on French protectionism see, David Todd, *Free Trade and its Enemies in France, 1814-1851*, (Cambridge University Press: Cambridge, 2015).
[98] 'Richard Cobden to Michel Chevalier, 14th Sep., 1859', in Anthony Howe and Simon Morgan (eds.), *The Letters of Richard Cobden*, Vol. 3 of 4: 1854-1859, (Oxford University Press: Oxford, 2012), pp. 454-57, 456.
[99] 'Richard Cobden to Michel Chevalier, 14th Sep., 1859', in Howe and Morgan (eds.), *The Letters of Richard Cobden*, pp. 454-57, 456.
[100] 'Richard Cobden to Michel Chevalier, 14th Sep., 1859', in Howe and Morgan (eds.), *The Letters of Richard Cobden*, pp. 454-57, 456.
[101] 'Richard Cobden to John Bright, 17th Oct., 1859', in Howe and Morgan (eds.), *The Letters of Richard Cobden*, pp. 467-9, 467.

With Palmerston's government keen to improve relations with Napoléon, Cobden seized his chance to promote this liberal economic measure. After discussing the matter with the Chancellor of the Exchequer, William Gladstone, Cobden travelled to Paris in October to open negotiations.[102] There, Cobden met with Napoléon and presented the case for free trade, but he also warned that without a treaty, conflict between their nations was likely.[103] The general consensus in Britain was that no regime professing the virtues of free trade could actively be planning on war.[104] Through late December and into 1860, negotiations continued until the treaty was signed on 23rd January. The British press, including *The Times*, reacted positively to this act, believing that such a liberal measure was an assurance of Napoléon's peaceful intentions.[105] Although limited in the extent to which tariffs were reduced on French imports, this was a hugely symbolic move against protectionism.[106]

During the negotiating of the Cobden-Chevalier Treaty, it became increasingly clear that liberal economic integration engendered broader questions over standardized measurement. Along with difficulties in regulating post between the two countries, of prime concern to French ministers was the reduction of duties on brandy and wine. Without an international system for measuring units of alcohol it soon became apparent that free trade would involve sharing standards. In November 1859, Cobden sent Gladstone a list specifying the alcoholic strength of various wines, calculated according to the methods of the French chemist Joseph Louis Gay-Lussac (1778-1850), while promising to send the Chancellor a set

[102] Enjoying a budget surplus, Gladstone was keen to find new ways of reducing taxes and so was pleased to remove duties on French imports, see Edsall, *Richard Cobden*, p. 331-2; Iliasu, 'The Cobden-Chevalier commercial treaty of 1860', p. 67.
[103] Edsall, *Richard Cobden*, pp. 334-5.
[104] Iliasu, 'The Cobden-Chevalier commercial treaty of 1860', pp. 93-4.
[105] For a discussion of British free trade, see John V. C. Nye, *War, Wine, and Taxes: the political economy of Anglo-French trade, 1689-1900*, (Princeton University Press: Princeton, 2007), pp. 89-109; for an economic analysis of the treaty see, Antonio Tena-Junguito, Markus Lampe, and Felipe Tâmega Fernandes, 'How much trade liberalization was there in the world before and after Cobden-Chevalier?', *Journal of Economic History*, Vol. 72, No. 3 (Sep., 2012), pp. 708-40.
[106] Edsall, *Richard Cobden*, p. 340; Britain abolished most duties on French imports and France reduced tariffs on certain goods and replaced prohibitions with 25-30% tariffs on others.

of French standardized instruments.[107] Cobden reported a week later that it seemed 'that the alcoholmeter of Gay Lussac is not so reliable for wine, as for alcohol & water'.[108] Although there had been practices for calculating alcoholic content in use since the eighteenth century, Louis XVIII signed a new law in June 1824 which designated Gay-Lussac's centesimal scale and alcoholmeter, measuring alcohol in terms of its specific gravity, as legal standards.[109] In 1859, Gladstone personally thought British instruments 'nicer' for calculating alcoholic content, but Chevalier maintained that with French instruments winemakers and bureaucrats had 'no difficulty in defining one degree of strength' and proposed a tax of a penny per degree.[110] Mutual agreement over accurate standard measures of alcohol were vital to securing Anglo-French free trade.

It was not just alcohol standards that the 1860 Cobden-Chevalier Treaty drew attention to. Integrated trade also meant that both the metric and imperial systems of weights and measures came under scrutiny; or as Cobden put it, the treaty should be followed by a 'free trade in arithmetic'.[111] At the 1851 Great Exhibition the problem of national variations in weights and measures had become very evident and, in 1853, the first International Statistical Congress was held in Brussels, preceding the establishment of the International Association for Obtaining a Uniform Decimal System of Measures, Weights, and Coins. With members including politically radical MPs Cobden and William Ewart, the association campaigned in

[107] 'Richard Cobden to William Gladstone, 21st Nov., 1859', in Howe and Morgan (eds.), *The Letters of Richard Cobden*, pp. 485-6.
[108] 'Richard Cobden to William Gladstone, 28th Nov., 1859', in Howe and Morgan (eds.), *The Letters of Richard Cobden*, pp. 489.
[109] Maurice Crosland, *Gay-Lussac: scientist and bourgeois*, (Cambridge University Press: Cambridge, 1978), pp. 190-3; Pierre Duplais, *A treatise on the manufacture and distillation of alcoholic liquors*, (Henry Carey Baird: Philadelphia, 1871), pp. 253-4.
[110] 'Richard Cobden to William Gladstone, 5th Dec., 1859', in Howe and Morgan (eds.), *The Letters of Richard Cobden*, pp. 491-2; 'Richard Cobden to William Gladstone, 29th Dec., 1859', in Howe and Morgan (eds.), *The Letters of Richard Cobden*, pp. 505-6.
[111] Quoted in, Schaffer, 'Metrology, Metrication, and Victorian Values', p. 446.

favour of the metric system throughout the 1850s, presenting a set of metric weights and measures to the Society of Arts in 1858.[112]

Two years after the signing of the Cobden-Chevalier Treaty, a parliamentary select committee reported on the chaotic state of Britain's weights and measures. Britain did have a national standard of length, the yard, which had become law under the 1824 Weights and Measures Act. Although this original standard had been lost in the fire which destroyed the Palace of Westminster in 1834, legislation passed in 1855 establishing the new imperial system of measures.[113] By 1862, however, it was clear that this standard had not unified national trade. The Astronomer Royal George Biddell Airy (1801-1892), who had chaired the commission to construct new imperial standards between 1843 and 1854, informed the 1862 committee that two thirds of the nation's local measures were used without re-verification and lacked accuracy.[114] Recognizing that Britain's measures should be unified, the committee endorsed the metric system, citing international integration as an important concern. It concluded that foreign powers were 'yearly becoming more and more mutually connected and mutually dependent; most of them composing the great European family of nations'.[115]

As with musical pitch, the introduction of the metric system carried with it political implications, fashioned largely through comparison between Britain's perceived liberal system of government and the more autocratic interventionist governments of the Continent. Airy asserted that the problem with introducing the metric system in Britain, or indeed any national standard, was that the British 'Government interferes less in the private concerns of the people than is the case anywhere else'.[116] To implement a national standard, Airy continued, would

[112] Edward Franklin Cox, 'The Metric System: a quarter-century of acceptance (1851-1876), *Osiris*, Vol. 13, (1958), pp. 358-79, 362-5; Samuel Brown, 'On the Metric System of Weights and Measures, and its proposed adoption in this country', *The Assurance Magazine, and Journal of the Institute of Actuaries*, Vol. 11, No. 5 (Apr., 1864), pp. 263-79.
[113] Schaffer, 'Metrology, Metrication, and Victorian Values', pp. 443-4.
[114] *Report from the Select Committee on weights and measures; together with the proceedings of the committee, minutes of evidence, appendix, and index*, House of Commons Paper 411 (1862), p. viii.
[115] Ibid., p. x.
[116] Ibid., p. 131.

require that the 'Government, instead of being passive, ought to be active on the question; and the readiest way to action is the appointment of an appropriate department, under a well selected chief'.[117] Likewise, Chevalier informed the committee that in France 'there is a department which superintends the proper observance of weights and measures; it is under the Minister of Commerce', as was the case in other countries which had adopted the metric system, such as Belgium.[118]

When Ewart brought a bill before the House of Commons in 1863, proposing the implementation of the metric system, a heated debate ensued. Foreseeing resistance due to metric's revolutionary connotations, Ewart observed that while the despotic Napoléon Bonaparte had actually abandoned the system, King Louis Philippe had reintroduced it between 1837 and 1840; the metre was not, therefore, the standard of an autocrat, but the measure of 'the monarch of the middle classes'.[119] The fact that the metric was French was nevertheless predictably divisive in the debates, with Conservative MP Joseph Henley (1793-1884) warning that adopting the metre would effectively hand authority for regulating the nation's trade to Paris. He feared that Britain was in a state of 'Gallo-mania' and was sceptical that 'the scientific men in France' had been able to accurately measure the earth's circumference.[120] Cobden weighed in on these debates, claiming that the metre was not inherently French, but international, observing that in 1790 the French government had invited 'learned Fellows of our Royal Society to France, to devise a system of weights and measures for the world', but that this invitation had been rejected.[121] This was therefore not, Cobden asserted, a French scheme for exerting influence, but one aimed at international unity. Perhaps surprisingly, the

[117] Ibid., p. ix.
[118] Ibid., p. ix.
[119] *Debate in the House of Commons on the proposed introduction of the Metric System of Weights and Measures, 1st July, 1863, corrected by the respective members who took part in the discussion*, (Bell and Daldy: London, 1863), p. 11.
[120] Ibid., pp. 16-7.
[121] Ibid., p. 29.

bill, including its specified abolition of 'the Imperial and all local or customary Weights and Measures' passed by 110 to 75 votes, with a second bill passing in 1864. Despite this, a further report in 1869 found that Britain was unprepared for the introduction of the metric system and advocated that further legislation be delayed.[122]

Conclusion

As much as mathematicians like Herschel laboured to establish a standard musical pitch which took its authority from nature, in the same way that the metre and the second had claims to be based on the measure of the Earth, music proved well beyond the control of mid-Victorian science. Music consists of techniques which rely on cooperation and integration; it is an inherently social activity which depends on unification, especially of time and pitch. Behind each sound is a complex network of industrial, institutional, and social structures, which meant that the regulation of pitch had implications throughout the nation. From congregations listening to church choirs and the auditory experiences of fashionable audiences at the opera, to the formation of a student's ear in a musical academy and the testing of an instrument in a workshop, the regulation of pitch symbolized a connection between international relations and society.

Although the earliest intentions of the Society of Arts' committee were to follow the French example, building a national consensus within the framework of a liberal political culture shaped an alternative approach to musical unification. Different resources had to be mobilized, specifically in terms of scientific knowledge and public consultation. The very nature of manufacturing a musical measure, without state apparatus, meant that Britain's pitch was quite different to the French standard. The catalyst for this divergence was the committee's

[122] Cox, 'The Metric System: a quarter-century of acceptance (1851-1876)', pp. 372-3; *Weights and Measures. A bill for decimalising our existing system of weights and measures, and for establishing an accordance between them and those of foreign countries*, House of Commons Papers 120 (1863), p. 3; also see Bernard Semmel, 'Parliament and the Metric System', *Isis*, Vol. 54, No. 1 (Mar., 1963), pp. 125-33; Joseph Mayer, '"Parliament and the Metric System" – comments', *Isis*, Vol. 57, No. 1 (Spring, 1966), pp. 117-19.

determination to cultivate uniformity in a manner consistent with liberal values. In attempting to produce a measure of pitch, the 1859 inquiry simultaneously produced a measure of British political culture, made entirely in reference to perceptions of the French state. In 1860, the difference between British liberalism and French autocracy ultimately came down to six vibrations per second.[123]

Here then, was an example of how hard it was to harmonize measures within contrasting political cultures. Crucially, this was not just a problem confined to music, but something that informed broader attempts at social-economic integration. At precisely the same time that in London musicians and mathematicians were debating the number of vibrations that should constitute a standard C, in Paris the negotiations surrounding the Cobden-Chevalier Treaty raised similar questions of measurement. And while the standardization of pitch was inseparable from English notions of liberalism and fears over French autocracy, these same cultural values were at the centre of discussions over the weights and measures which were so important to facilitating free trade. As with musical pitch, in debates over the metric system, politicians, economists, and natural philosophers wrangled with the challenge of building a liberal consensus and regulating society without state intervention. It is hardly surprising that, in 1859, Herschel thought music the third fundamental measure of the universe.

[123] According to the Society of Arts' 1860 report on pitch, the French *diapason normal*, at A435, was equivalent to a C of 522 vibrations, compared to the British recommendation of C528.