CHAPTER 8

Mary Somerville's Sound Accomplishments

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In her 1798 treatise, *Practical Education*, the novelist Maria Edgeworth criticized the state of women's education at the turn of the nineteenth century, deriding 'hours spent stammering at a harpsichord' as a mere entryway to fashionable society or as a form of competitive display for matrimonial gain.[1] Without rejecting traditional recreations such as piano playing, drawing, and dance, she cautioned against what she perceived as an overestimation of superficial accomplishments at the expense of meaningful scientific knowledge:

> Sentiment and ridicule have conspired to represent reason, knowledge, and science, as unsuitable or dangerous to women; yet at the same time wit, and superficial acquirements in literature, have been the object of admiration in society; so that this dangerous inference has been drawn almost without perceiving its fallacy, that superficial knowledge in women is more desirable than accurate knowledge.[2]

Edgeworth's critique of 'female accomplishments' was a significant contribution to a growing critique of education that prioritized a rota of accomplishments over the life of the mind.[3] But whereas her criticisms exemplify debates taking place about the nature of 'accomplishments' and the domestic education of girls in the 1790s, they also point to the growing prominence of women as public intellectuals within this emerging knowledge economy.

Women writers certainly faced exclusionary assumptions and tactics in the professionalizing disciplines of both science and music. Yet they also played a key role in conveying knowledge to a wide readership and advancing an ideal of scientific education as a rational pursuit for both women and men.[4] The science writer and polymath Mary Somerville (née Fairfax) stands as a case in point. Somerville's early success owed much to a culture of scientific practice as a genteel accomplishment, one accessible to men and women in a range of settings beyond professional arenas. Born in

Scotland in 1780, Somerville moved to London with her husband in 1816.[5] From an affluent residence in Chelsea and through travel in France and Italy, she became an authority on advanced mathematics, astronomy, and experimental physics, while also pursuing her musical interests in opera and piano playing.[6] In her best-selling treatise *On the Connexion of the Physical Sciences* (1834), she sought to unify different branches of knowledge ranging from astronomy, optics, and electricity to acoustics and musical sound.

Following the first biographies of Somerville to appear in the late twentieth century, historians of science such as James Secord and Claire Brock have done much to uncover the tensions in her work as a female intellectual while integrating her achievements into mainstream histories of nineteenth-century science.[7] Somerville's *Connexion* has been analysed particularly for its contributions to optics, for its philosophical reflections on nature and astronomy, and for its relevance to Victorian debates about public education.[8] What is less often considered is that Somerville also drew on the latest experiments of the day to include two pivotal chapters on sound.[9] Somerville's work introduced the emerging field of acoustics to a mass readership. What is more, sound and music recur throughout her treatise as part of her broader project to draw connections between the physical sciences. Although her writing on sound was ultimately superseded by more specialist accounts later in the century, it was important in cultivating a public fascination with the possibilities of acoustical science and practices of listening within and beyond nineteenth-century London. Amid growing scholarly attention to interactions between histories of science and aurality, Somerville stands as a popular disseminator of philosophies of sound, rather than as an inventor, maker, and demonstrator of new theories and technologies. Rather than disparage her contribution on these grounds, however, this chapter interprets her writing on acoustics and its reception as an alternative to histories of seminal machines and experimental practices that privilege men as theorists of sound and hearing in modernity.

Narrating the Science of Sound

In the context of an industrializing London, the quest to understand sound as an object of scientific knowledge was attracting new pioneers and audiences. As James Q. Davies and Ellen Lockhart have stated, 'concern for music and concern for science were often one and the same; the differences between "optical" and "auditory" inquiry, between "music"

and "science", between what counted as "musical performance" and what counted as "scientific performance" were often difficult to define'.[10] Such convergences were in many ways indicative of the physical sites of performance and exhibition characteristic of London's urban expansion in the early decades of the century. Scientific establishments such as the Royal Institution, the Royal Society, and the Royal Polytechnic Institution functioned as lively spaces for public demonstration and spectacle alongside cultural venues such as the Hanover Square Rooms, the King's Theatre, and Crystal Palace. At the same time, the blurring of musical and scientific performance depended upon the activities of individual protagonists known both for their insights into acoustical science and technology and for their wide-ranging interests across the arts and sciences. Recent scholarship has shown how sound and music were important preoccupations of male luminaries such as John Herschel, Thomas Young, Michael Faraday, and Charles Wheatstone – all of whom built their reputations as lecturers and demonstrators by establishing strong connections with London's emergent scientific institutions.[11]

If urban institutions provided exhilarating public spaces of musical and scientific convergence, they nevertheless functioned in other ways as patriarchal sites of exclusion. In contrast to the array of public sites occupied by men of science, female intellectuals were restricted from lecturing in institutional spaces, and had to rely on printed media and informal social networks as a means to acquire and circulate knowledge. Unlike her male contemporaries, Somerville did not participate in institutional meetings and was never permitted to lecture in public.[12] Instead, she conveyed scientific knowledge in writing to a wider public of educated non-specialists. Her first book, *Mechanism of the Heavens* (1831), was a translation and explication of Pierre-Simon Laplace's complex treatise on mathematical physics, *Mécanique celeste* (1798–1827). The translation was connected with the ambitions of the Whig politician and mathematician Henry Brougham, who sought to bring science to middle- and working-class people through the inexpensive publications of the Society for the Diffusion of Useful Knowledge.[13] Although Somerville's *Mechanism of the Heavens* ultimately proved unsuitable for a general audience, she had prepared an introduction to Laplace's treatise, a 'Preliminary Dissertation', in which she set out a non-mathematical context for readers unversed in advanced calculus and experimental physics. This would evolve into *Connexion*, which she completed during her stay in Paris in 1832 and was accepted for publication shortly after her return to London the following year.

In the context of acoustical science, Somerville can be read alongside other British and European thinkers who shared the liberal aspiration to communicate theories of sound and hearing to a mass readership, even as scientific disciplines became more specialized and fragmented. As Benjamin Steege points out in reference to Hermann von Helmholtz's *Die Lehre von den Tonempfindungen* (*On the Sensations of Tone*, 1863), the commitment to 'popular science' as a way of observing and interpreting everyday sensory experience coincided with the growth of modern acoustics as a highly technical branch of mathematical physics.[14] Even before Helmholtz's seminal treatise, John Herschel's 'Treatise on Sound' of 1830 prompted discussion about scientific cultivation and public understanding in Britain. Herschel's survey makes few concessions in its extensive use of technical language to outline the propagation of sound and the laws of vibration. In a lengthy review, David Brewster remarked that Herschel's treatise 'is fitted only for the perusal of the mathematical philosopher; and though the general reader will discover, here and there, portions which he is capable of understanding, yet he will find himself baffled at every step by profound views, and by the perpetual recurrence of mathematical formulae'.[15] Highlighting the disjunction between a minority in possession of high-level technical training and a growing readership of 'educated classes', Brewster went on to stress the need for 'a series of works on popular and practical science, freed from mathematical symbols and technical terms, written in simple and perspicuous language, and illustrated by facts and experiments which are level to the capacity of ordinary minds'.[16] Wasting no time in embarking on such a project, he devoted the remaining thirty pages of his review to providing his own 'popular account' of discoveries in sound by way of commentary on Herschel's treatise. Two years later, Brewster published his popular account of acoustics and musical automata in his *Letters on Natural Magic Addressed to Sir Walter Scott* (1832), wherein he employed straightforward description and diagrams to expose the mechanisms underlying 'magical' phenomena, including the production of sounds by musical instruments and automata.[17]

Despite her autodidactic background in advanced mathematics and Laplacian physics, Somerville followed Brewster in omitting algebraic formulae from her treatise. While she acknowledged that 'a complete acquaintance with physical astronomy can be attained by those only, who are well versed in the higher branches of mathematical and mechanical science', she also admitted that 'there is a wide distinction between the degree of mathematical acquirement necessary for making discoveries, and

that which is requisite for understanding what others have done'.[18] Unlike Brewster, who employed a tone of scientific conquest and rationalistic unmasking of the supernatural, Somerville's rhetoric used evocative description and metaphor to demystify the natural world while inspiring a sense of wonder at divine creation.[19]

In the opening pages of her discussion, Somerville illustrates the propagation of sound by way of an analogy with a field of corn set in motion by a gust of wind and marked by different-coloured bands. The oscillation of individual ears of corn stands in for the vibration of particles of air, while the ripples of the cornfield depict the transmission of sound waves in an equal direction:

> A sudden blast depresses each ear equally and successively in the direction of the wind; but in consequence of the elasticity of the stalks and the force of the impulse, each ear not only rises again as soon as the pressure is removed, but bends back nearly as much in the contrary direction, and then continues to oscillate backwards and forwards, in equal times, like a pendulum, to a less and less extent, till the resistance of the air puts a stop to the motion. These vibrations are the same for every individual ear of corn. Yet as their oscillations do not all commence at the same time, but successively, the ears will have a variety of positions at any one instance. Some of the advancing ears will meet others in their returning vibrations, and as the times of oscillation are equal for all, they will be crowded together at regular intervals. Between these, there will occur equal spaces where the ears will be few, in consequence of being bent in opposite directions; and at other equal intervals they will be in their natural right position. So that over the whole field there will be a regular series of condensations and rarefactions among the ears of corn, separated by equal intervals, where they will be in their natural state of density. (*Connexion*, 150)

Here Somerville invokes Alexander von Humboldt's observations on the amplification of nocturnal sound as described in his *Ansichten der Natur* (*Views of Nature*). Recounting his expedition to the cataracts of the Orinoco river, Humboldt had attributed the intensified sound of water at night to changes in the density of the atmosphere. As Somerville points out, Herschel subsequently confirmed Humboldt's observations. But in writing with an ear towards urban life in the 1830s, Herschel had also attributed the augmentation of common sounds to the repose of night, which – he believed – heightened the auditory nerves in the same way as darkness makes the stars transparent (*Connexion*, 158). Continuing her tour of sonic discoveries, she elaborates on issues of intensity and pitch, detailing experiments on sounds inaudible to human ears by William

Hyde Wollaston and Wheatstone. She evokes Jean-Baptiste Biot's whispered conversations through the pipes of the Paris aqueducts, revealing how the force of sound does not decay in a tube as in open air. Turning to the specific phenomenon of music and the long-standing scientific fascination with musical instruments, she describes the laws of frequency underlying unison, consonant, and dissonant sound combinations as a basis for pleasure in musical beauty. She echoes Thomas Young in inferring that the scientific laws of frequency can be extended to justify a universal and natural human propensity for diatonic harmony. 'The pleasure afforded by harmony', she notes, 'is attributed by Dr. Young to the love of order, and to a predilection for a regular occurrence of sensations, natural to the human mind, which is gratified by the perfect regularity and rapid recurrence of the vibrations' (*Connexion*, 166).

At the centre of her treatise, Somerville documents modern acoustics as a burgeoning field preoccupied with observing and quantifying the vibration of bodies. She devotes considerable space to Ernst Chladni's experiments in revealing acoustic waves as geometric figures (*Connexion*, 168–69). She focuses on the various symmetrical arrangements of sand produced by the different modes of vibration, and alludes to the wider ongoing fascination with 'Chladni figures' in more recent acoustical science. Through close observation of Chladni's experiments, Wheatstone had shown how complex patterns could be understood according to a simpler set of basic geometric figures (*Connexion*, 170).[20] Meanwhile, Félix Savart's observations of sound patterns produced by fine sand had considered the implications of sympathetic vibration for detecting the effect of sound transmission on the atmosphere. Somerville recounts how the movement of sand on stretched parchment over a large glass tumbler can be made to follow the vibrations produced by a parallel plate set in motion, or by the notes of a flute played nearby. The technique can even be utilized – she notes – to detect inaudible and distant sounds, holding implications for refining siege warfare: 'by the vibrations of sand on a drum-head, the besieged have discovered the direction in which a countermine was working' (*Connexion*, 175–76, quotation at 176).

If Somerville foregrounds theories of vibration and the legacy of the 'Chladni figures', she also records new instruments of early nineteenth-century acoustics. Charles de la Tour's improved siren of 1819 was initially used for quantifying the number of pulsations in a second corresponding to any particular pitch, while Wheatstone's symphonion, concertina, and Aeolian organ applied vibrating metal springs to expressive effect (*Connexion*, 168). In the concluding pages of her survey, she credits

Wheatstone for providing some of the most progressive information on sound transmission and resonance. Wheatstone's experiments on solid conductors worked to connect instruments and soundboards in separate spaces, enabling audiences to hear a musical performance as reproduced without the presence of the players in front of them.[21] As Somerville puts this: 'The sounds of an entire orchestra may be transmitted and reciprocated by connecting one end of a metallic rod with a sounding-board near the orchestra, so placed as to resound to all the instruments, and the other end with the sounding-board of a harp, piano, or guitar, in a remote apartment' (*Connexion*, 177). Somerville incorporates Wheatstone's depiction of listening to a transmission of his orchestra through a soundboard as similar to viewing the detail of a distant landscape: 'compared with an ordinary band heard at a distance through the air the effect is as a landscape seen in miniature beauty through a concave lens compared with the same scene viewed by ordinary vision through a murky atmosphere' (*Connexion*, 177).

If Wheatstone's musical circuits could transmit sounds across geographical distances, Somerville concludes with the suggestion that parallel developments in the invention of speaking machines would one day carry sound across vast reaches of time:

> From the singular discoveries of M. Savart on the nature of the human voice, and the investigations of Mr. Willis on the mechanism of the larynx, it may be presumed that ultimately the utterance or pronunciation of modern languages will be conveyed, not only to the eye, but also to the ear, of posterity. Had the ancients possessed the means of transmitting such definite sounds, the civilized world would still have responded in sympathetic notes at the distance of hundreds of ages. (*Connexion*, 179)

Of course, Somerville was not alone in imagining a utopian future of sound technology, one in which the reproduction and preservation of vocal utterance could link cultures and peoples across spatial and temporal divides. Herschel had similarly concluded his 'Treatise on Sound' with a section concerned with Savart's observations on the anatomy of the voice, and with Wolfgang von Kempelen's and Robert Willis's use of reed pipes and bellows in constructing 'talking engines' for the purpose of imitating vowel sounds. In documenting such discoveries, Herschel commented on what he saw as the wider limitations of written language in the context of modern trade relations and alluded to the possibility of capturing speech sounds in the form of a standardized phonetic alphabet. The task of preserving 'an exact correspondence between the writing and pronunciation', he argued, 'would be one of the most valuable acquisitions not only

to philologists but to mankind, facilitating the intercourse between nations, and laying the foundation of the first step towards a universal language'.[22] Somerville's aspiration to communicate knowledge of acoustics to new audiences was certainly in keeping with a liberal agenda to reach a mass public. Still, her historical narrative of sound innovations and imaginations of the future was equally implicated in the wider imperial project to elevate Western science in the service of 'civilizing' humanity on the model of Victorian progress.

Acoustics Imprinted

While *Connexion* was by no means a straightforwardly popular work, it was widely praised in the British periodical press for its lucidity, elegance, and scope. William Whewell lauded Somerville's treatise for its bold attempt to counteract the modern tendency of the sciences towards 'separation and dismemberment'.[23] Aligning Somerville's work with the aims of the newly established British Association for the Advancement of Science (1831), Whewell used his review to moot the novel term 'scientist' as a fitting description of those individuals (including Somerville) who were engaged in observing and explicating the natural world in a manner that counteracted the pitfalls of specialization.[24] Not surprisingly, many of Somerville's male critics were unable to resist categorizing her intellectual qualities and style according to ideological stereotypes. Even Whewell (one of her most positive reviewers) depicted Somerville as both a singular exception to what he saw as an overall scarcity of female authors capable of comprehending the sciences, and somehow exemplary of the 'female intellect' in general – which he demarcated as steered by emotion, feeling, and a sharpness of perception freed from practical implications.[25] Meanwhile, the *Athenaeum* singled out the sections on sound in particular as the best in the book, suggesting that the treatise as a whole was 'at the same time a fit companion for the philosopher in his study, and for the literary lady in her boudoir; both may read it with pleasure, both consult it with profit'.[26]

Whereas Brewster had criticized Herschel's 'Treatise on Sound' for its intractability, he commended Somerville in the *Edinburgh Review* for conveying profound knowledge of the material world with rare elegance and without 'entering into minute details of facts, or diffuse explanations of phenomena, or tedious deductions of general laws'.[27] He went on, though, to doubt whether the treatise was 'sufficiently popular to initiate our fair countrywomen into a knowledge of the laws of the material

universe' and to level criticisms against the lack of diagrams and visual aids in the first edition.[28] As he saw it, Somerville's chapters on acoustics were most defective in this regard as they included no illustrations of the symmetrical patterns produced by the vibration of solid bodies. Implying a dissociation between sound as an aural phenomenon and as a visual trace, he argued that 'there is no branch of physics which addresses itself so agreeably to the eye, or appeals with such force to our wonder, as that of acoustic figures; and, connected as it is with the theory and practice of music, we must implore Mrs Somerville to give it, in another edition, a more favourable consideration'.[29] When Somerville came to publish the second edition of *Connexion* in 1835, she responded to this recommendation by supplementing her written text with diagrams and full-page illustrative plates, including several depicting Chladni's sound figures and their reconfiguration by Wheatstone.

By the late 1830s, Somerville's treatise found popularity through its serialization in new penny weeklies aimed at 'improving' middle- and working-class readers engaged in self-education.[30] *The Saturday Magazine* had been founded in 1832 under sponsorship from the missionary organization the Society for Promoting Christian Knowledge and reached a peak circulation of 80,000. In September 1837 it began its serialization of Somerville's text, not with extracts from the opening sections of the book as one might expect, but with an introductory segment from the chapters on sound. In this context, knowledge of acoustical science was interspersed with articles on 'exotic locales', elements of science and nature, references to art, composers, and musical instruments, and 'lessons in Christian evidence'.[31] Meanwhile, an earlier edition of the rival *Penny Magazine* from the same year had announced a new regular feature entitled 'Philosophical Experiments which, by means of Apparatus within the reach of every person, may be easily performed'.[32] The first in the series involved an explanation of acoustics, showing how the undulations of sound could be visualized as vibrating objects, as particles of dust in the light, or as figures of sand on plates of glass. The final 'home experiment' depicts Wheatstone's Kaleidophone, a popular ornament designed to reveal how acoustic vibrations of different pitches could produce geometric patterns of coloured light in the dark.

Somerville's Sonorous Romanticism

It might be tempting, in view of this reception, to read Somerville's survey merely as exemplary of a well-worn narrative in sound historiography: that

of a growing propensity to objectify, commoditize, and visualize sound and hearing as characteristic of 'sonic modernity'. Beginning in the late eighteenth century (so this narrative goes), the growth of acoustics as a specialist branch of physics transformed the way sound was perceived; sound became a tangible object of close analysis and observation. Once this objectification took hold in Victorian 'aural culture', it provided the necessary conditions for the technologized sound world of the modern era. John Picker has suggested that authors such as Herschel, Brewster, Wheatstone, and Somerville marked a transition in perceptions of sound and listening between the Romantic and Victorian eras. These figures, he argues, sought to demystify the immaterial realms of sound and hearing, paving the way for innovations in sound reproduction later in the century. If Romantic poets and authors conceived of sound as a 'sublime *experience*', early Victorian popularizers of science established sound as a 'quantifiable and marketable *object* or *thing*'.[33]

In her survey of the fast-growing field of acoustical science for a mass readership, Somerville's tone of scientific progress certainly shifts from a focus on the acoustic properties of music and instruments towards vibration as a marker of sound in general. Yet to infer from her text (or from those of her contemporaries) a widespread shift in perceptions of sound and listening would be to exaggerate the causal impact of scientific theory on sensory experience, and to overlook the extent to which sound and music were integral to her broader philosophy of nature and the senses as connected and entwined. It seems ironic that the sections of Somerville's book on sound were extracted as individual items of 'useful knowledge', when her motivating premise was to advocate for the unity of the physical sciences. As she put this in her preface, 'the progress of modern science, especially within the last five years, has been remarkable for a tendency to simplify the laws of nature, and to unite detached branches by general principles' (*Connexion*, iv).

While Somerville does not offer a principle of unity, she presents connectivity as an implied possibility between different fields, citing developments in electromagnetism and sound–light analogy, and deferring to the idea of cosmic harmony as the work of divine creation. In her book, sound provides a recurring point of reference, as the embodiment of waves and undulations and as symbolic of the overarching theme of connection. In the introduction, she employs a sonic metaphor to illustrate the unity of the physical sciences, which she sees exemplified in astronomy.

> Gravitation not only binds satellites to their planet, and planets to the sun, but it connects sun with sun throughout the wide extent of creation, and is

> the cause of the disturbances, as well as of the order, of nature: since every tremor it excites in any one planet is immediately transmitted to the farthest limits of the system, in oscillations, which correspond in their periods with the cause producing them, like sympathetic notes in music, or vibrations from the deep tones of the organ. (*Connexion*, 2)

Somerville uses the Newtonian connection of gravity with the harmony of the spheres to frame her presentation of astronomy as the most 'sublime subject of study'. As she sees it, contemplation of the heavens takes one closer to the operation of divine principles, while at the same time showing their impenetrability: 'such pursuits, while they ennoble the mind, at the same time inculcate humility, by showing that there is a barrier which no energy, mental or physical, can ever enable us to pass' (*Connexion*, 2).

In her later chapters on sound, Somerville returns to the association of harmony and vibration with the movement of bodies. She begins with an explanation of sympathetic vibration between musical instruments, describing the effect of placing a sounding tuning fork on a pianoforte. Following further examples of musical and temporal correspondence, she reflects on the relevance of sympathetic vibration more generally for the larger theme of her book:

> These forced oscillations, which correspond in their periods with those of the exciting cause, are to be traced in every department of physical science. Several instances of them have already occurred in this work. Such are the tides, which follow the sun and moon in all their motions and periods. The nutation of the earth's axis also corresponds with the period, and represents the motion of the nodes of the moon, and may be traced in the nutation of the lunar orbit. And, lastly, the acceleration of the moon's mean motion represents the action of the planets on the earth reflected by the sun to the moon. (*Connexion*, 173–74)

The moment of self-reference in this passage – where Somerville refers back to preceding examples already given in the work – shows the extent to which her idea of connection also operates on a rhetorical level. Indeed, commentators have noted the extent to which the sectional arrangement of the text is designed to show how knowledge in one area holds implications for ideas and concepts in another.[34] The chapters on sound are no exception, and their literal positioning at the centre of the work is significant: they occupy a pivotal position between the survey of astronomy and atmosphere on the one side, and the discussion of light, heat, and magnetism on the other. As if to justify this ordering of knowledge, the sections on light begin with the corresponding assertion that 'not only every thing we hear, but all we see, is through the medium of the

atmosphere' (*Connexion*, 180). This anticipation of analogy between sound and light suggests a further reference to Young – whose quest for relations between different fields led him to study acoustics as a foundation for his wave theory of light.[35] In the wake of Young's experiments, Somerville was able to reflect more broadly on the undulations of sound as a prior case from which to understand other senses. She suggests, for instance, that 'all the principal phenomena of heat may actually be illustrated by a comparison with those of sound' and that 'light, heat, sound, and the waves of fluids, are all subject to the same laws of reflection, and, indeed, their undulatory theories are perfectly similar' (*Connexion*, 260). She goes on to distinguish the medium of sound, describing its distinct physical properties through lyrical language reminiscent of her framing musical metaphor:

> The propagation of sound requires a much denser medium than that of either light or heat; its intensity diminishes as the rarity of the air increases; so that, at a very small height above the surface of the earth, the noise of the tempest ceases, and the thunder is heard no more in those boundless regions where the heavenly bodies accomplish their periods in eternal and sublime silence. (*Connexion*, 260)

Somerville's text invites us to attend as much to her written style as to her theoretical positions and influences. This was the approach adopted by Maria Edgeworth, who singled out the above passage on the propagation of sound as exemplary of the scientific sublime. Remarking on the strange combination of pleasure, awe, and discomfort she felt on reading the words on the page, Edgeworth complimented Somerville on her simplicity of style, which she thought conveyed a philosophy of science as a devotional encounter with nature:

> I can only assure you that you have given me a great deal of pleasure; that you have enlarged my conception of the sublimity of the universe, beyond any ideas I had ever before been enabled to form. The great simplicity of your manner of writing, I may say of your *mind*, which appears in your writing, particularly suits the scientific sublime – which would be destroyed by what is commonly called fine writing.[36]

Clearly Edgeworth experienced Somerville's text as more than merely an empirical explanation of the physical world, one that connected diverse branches of knowledge for the uninitiated reader. Beyond the dedicated account of acoustics at the centre of the book, references to music and sound emerge throughout the text – particularly, it seems, at moments when her writing starts to blur the boundaries between empirical

description and figurative display. In this sense, sound in *Connexion* is more than a material object, subject to elucidation and analysis; it is a literary theme central to the text's larger convergence of scientific writing with theology and poetry.

Gendering the 'Audible Past'

Although Somerville went on to publish two further books (*Physical Geography*, 1848, and *Molecular and Microscopic Science*, 1869), *Connexion* emerged as one of the most widely read scientific texts of the Victorian era. As Secord has documented, the first edition sold some two thousand copies and over the next four decades the book went through a further nine editions, reaching readers in Germany, Italy, France, colonial India, South Africa, and America.[37] In the decades following its initial publication, Somerville bolstered the credibility of her treatise throughout its successive editions by diligently keeping up to date with the latest discoveries and inventions of the day. Already in the second edition of 1835, she was compelled to add a new preface, declaring that 'many parts have been altered, and much new matter has been added, in order to keep pace with the rapid progress of the physical sciences' (*Connexion*, iii). But whereas she revised and updated many aspects of her treatise, the substance of her discussion of sound remained largely unaltered in fundamentals. The tenth and final edition of *Connexion*, which was edited by Arabella Buckley, the science writer and former assistant to Charles Lyell, appeared in 1877, five years after Somerville's death at the age of ninety-one.

To a certain extent Somerville's survey of sound may have appeared anachronistic by the 1870s, as new understandings of sound and emergent technologies of sound reproduction emerged. The appearance of Helmholtz's *On the Sensations of Tone* marked a seminal turn towards auditory perception and the physiology of hearing as the centre of acoustical research. New machines such as the Phonautograph and Phonograph superseded earlier aspirations for a 'talking engine' by shifting attention from the anatomy of the voice to the mechanisms of the human ear. Jonathan Sterne has depicted such developments as emblematic of a 'new sonic regime' that took hold in the mid-nineteenth century, one in which Alexander Graham Bell's Ear Phonautograph (1874) embodied a widespread orientation towards the mechanisms of the middle ear as the 'timpanic model' for sound reproduction technologies of the future.[38] It would be limiting, though, to evaluate Somerville's contribution to nineteenth-century sound science merely according to the narrative of

modern sound reproduction. Somerville's popularization of acoustics stands as an important model for the proliferation of knowledge about sound and listening in the Victorian public sphere more widely. Her reformist approach to scientific communication predated Helmholtz's liberal commitment to engage a broad non-specialist audience, and anticipated the later activities of the physicist John Tyndell, whose public lectures on sound at the Royal Institution helped to disseminate Helmholtz's theories. The appeal of Somerville's chapters on sound to a mass audience were indicative of a burgeoning engagement with the science of acoustics among Victorian readers and publishers – as was evident in later texts ranging from Sedley Taylor's *Sound and Music* (1873) and William Pole's *The Philosophy of Music* (1879) to scientific books aimed at children, such as Arabella Buckley's survey of sound at the centre of her book *The Fairy-Land of Science* (1878). Indeed, if Somerville's discussion of acoustics in *Connexion* stopped short of popularizing new theories of hearing later in the century, Buckley disseminated the latest understandings of sound and the ear by way of long-standing conversations of women's science writing that Somerville helped establish.[39]

Moving from sites of innovative scientific experiment and demonstration to a consideration of female popularisers of sound science might seem in some ways like a distraction from a current tendency of historians to unearth material histories of sound as mediated by technology in a period of rapid change. Yet an over-emphasis on technological invention and innovation in sonic artefacts also risks preserving an all-too-familiar binary: one in which men are cast as the producers and originators of knowledge about sound and hearing, while women play the part of audience members, listeners, and beneficiaries of acoustic discoveries.[40] Somerville does not conform to historical narratives of nineteenth-century music and science as centred on technological experimentation. But exploring the place of sound and hearing in women's science writing, and in their experience of acoustical science, provides another perspective on this shared disciplinary space, allowing for a variety of voices in the shaping of musical knowledge in this period.

Notes

1 Maria Edgeworth and Richard Lovell Edgeworth, *Practical Education* (London: J. Johnson, 1798), 522. On the role of music (and domestic keyboard performance in particular) within Enlightenment critical discourse on 'accomplishments' see Arthur Loesser, *Men, Women and Pianos: A Social History* (New York: Simon Schuster, 1954; reprint, New York: Dover, 1990),

267–83; and Gillen D'Arcy Wood, *Romanticism and Music Culture in Britain, 1770–1840: Virtue and Virtuosity* (Cambridge: Cambridge University Press, 2010), 151–79.

2 Edgeworth, *Practical Education*, 551.

3 Most notably, Mary Wollstonecraft had already criticized the limitations of domestic tutoring and boarding schools in her *Thoughts on the Education of Daughters* (1787), remarking on the tendency to train the memory by way of 'exterior accomplishments' in music, drawing, and geography while neglecting the cultivation of rational understanding and independence of thought: *Thoughts on the Education of Daughters, with Reflections on Female Conduct in the Important Duties of Life* (London: J. Johnson, 1787), 25. In the 1790s, Wollstonecraft would go beyond her initial critique of accomplishments to propose an overhaul of the national education system as a whole, arguing for co-education of girls and boys according to a shared curriculum within state-sponsored day schools: *Vindication of the Rights of Woman* (London: J. Johnson, 1792).

4 Marina Benjamin, 'Elbow Room: Women Writers on Science, 1790–1840', in *Science and Sensibility: Gender and Scientific Enquiry, 1780–1945*, ed. Marina Benjamin (Oxford: Blackwell, 1997), 27–59; Bernard Lightman, *Victorian Popularizers of Science: Designing Nature for New Audiences* (Chicago: University of Chicago Press, 2007), 95–166; Anne B. Shteir, 'Elegant Recreations? Configuring Science Writing for Women', in *Victorian Science in Context*, ed. Bernard Lightman (Chicago: University of Chicago Press, 1997), 236–55.

5 For biographies of Somerville, see Elizabeth Patterson, *Mary Somerville and the Cultivation of Science, 1815–1840* (Boston: Thoemmes Press, 2004), 11–47; and Kathryn A. Neeley, *Mary Somerville: Science, Illumination and the Female Mind* (Cambridge: Cambridge University Press, 2001), 45–85.

6 J. M. W. Turner's unfinished painting *The Music Party* depicts an elegant yet indistinct circle of figures playing and listening to music within a lavish interior setting. The most prominent figure in the painting – the woman at the piano with her back to the viewer – resembles a fleeting drawing from Turner's Paris sketchbook of 1832. The sketch has been linked to Mary Somerville, who was also residing in Paris that year and was well acquainted with Turner. See www.tate.org.uk/art/artworks/turner-music-party-east-cowes-castle-n03550 (accessed 29 December 2018).

7 Claire Brock, 'The Public Worth of Mary Somerville', *British Society for the History of Science*, vol. 39, no. 2 (2006), 255–72; James A. Secord, 'General Introduction', in *Collected Works of Mary Somerville*, ed. James A. Secord, 9 vols. (Bristol: Thoemmes Press, 2004), vol. 1, xv–xxxix; James Secord, 'Mathematics for the Million? Mary Somerville's *On the Connexion of the Physical Sciences*', in his *Visions of Science: Books and Readers at the Dawn of the Victorian Age* (Oxford: Oxford University Press, 2014), 107–269.

8 Secord, *Visions of Science*, 107. Secord suggests that Somerville's text sits alongside other exemplary works of the 'reflective genre' of science writing

common in the 1830s, including John Herschel's *Preliminary Discourse on the Study of Natural Philosophy*, Humphry Davy's *Consolations of Travel*, Charles Lyell's *Principles of Geology*, and Charles Babbage's *Reflections on the Decline of Science*. This genre not only disseminated scientific content, but also popularized ideas about the moral purpose and potential of Western science in the modern world.

9 The foregrounding of the visual sense in contemporary commentary on Somerville's work is reflected in titles such as Secord's *Visions of Science* and Neeley's *Mary Somerville*.

10 James Q. Davies and Ellen Lockhart, 'Introduction: Fantasies of Total Description', in *Sound Knowledge: Music and Science in London, 1789–1851*, ed. James Q. Davies and Ellen Lockhart (Chicago: University of Chicago Press, 2016), 1–26, quotation at 4.

11 Wheatstone in particular emerges as a significant figure within the acoustic environment of early nineteenth-century London. Although he is best known for his contributions to the invention of the electric telegraph, musicologists and historians of science have suggested that Wheatstone's artisan background as a musical instrument maker and inventor of musical automata in the 1820s and 1830s holds wider implications for an understanding of the cultural and social meanings of acoustic artefacts and scientific objects. See, for example, Ellen Lockhart, 'Transparent Music and Sound–Light Analogy ca. 1800', in *Sound Knowledge*, ed. Davies and Lockhart, 77–100; Myles W. Jackson, 'Charles Wheatstone: Musical Instrument Making, Natural Philosophy, and Acoustics in Early Nineteenth-Century London', in *Sound Knowledge*, ed. Davies and Lockhart, 101–24; Melissa Dickson, 'Charles Wheatstone's Enchanted Lyre and the Spectacle of Sound', in *Sound Knowledge*, ed. Davies and Lockhart, 125–44; James Q. Davies, 'Instruments of Empire', in *Sound Knowledge*, ed. Davies and Lockhart, 145–74; Peter Pesic, *Music and the Making of Modern Science* (Cambridge, MA, and London: MIT Press, 2014), 161–215; and Peter Pesic, 'Thomas Young's Musical Optics: Translating Sound into Light', in 'Music, Sound and the Laboratory from 1750–1980', ed. Alexandra Hui, Julia Kursell, and Myles W. Jackson, special issue of *Osiris*, vol. 28 (2013), 15–39.

12 See James Secord, 'How Scientific Conversation Became Shop Talk', in *Science in the Marketplace: Nineteenth-Century Sites and Experiences*, ed. Aileen Fyfe and Bernard Lightman (Chicago: University of Chicago Press, 2007), 23–59.

13 In 1827 Brougham commissioned Somerville to produce an accessible translation and summary of Laplace's treatise. Although she completed the translation according to Brougham's terms, she had reservations about the possibility of popularizing Laplace's arguments. For a detailed account of Somerville's connection with Henry Broughan and the publication context of *Connexion*, see Secord, 'Introduction', in Somerville, *Collected Works*, vol. 2, ix–xvi.

14 Benjamin Steege, 'Popular Sensations', in his *Helmholtz and the Modern Listener* (Cambridge: Cambridge University Press, 2012), 16–42, esp. 18–19.
15 David Brewster, 'A Treatise on Sound, by J. F. W. Herschel', *Quarterly Review* (February 1831), 475–510, quotation at 476.
16 Ibid., 476.
17 David Brewster, *Letters on Natural Magic Addressed to Sir Walter Scott* (London: John Murray, 1832), 149–67.
18 Mary Somerville, *On the Connexion of the Physical Sciences* (London: John Murray, 1835), 3. Hereafter cited as *Connexion* followed by page reference.
19 On Somerville's scientific language in *Connexion* and the influence of poetry, see Neeley, *Mary Somerville*, 5–10 and 101–29.
20 See Jackson, 'Charles Wheatstone', 105–11; Dickson, 'Charles Wheatstone's Enchanted Lyre', 129–33.
21 See Dickson, 'The Enchanted Lyre', 133–42; and Jackson, 'Charles Wheatstone', 113–21.
22 F. W. Herschel, 'A Treatise on Sound', in *Encyclopaedia Metropolitana, or, Universal Dictionary of Knowledge*, ed. Edward Smedley (London: Rest Fenner, 1830), vol. 2, 818.
23 William Whewell, 'Review of *On the Connexion of the Physical Sciences*', *Quarterly Review*, vol. 15 (March 1834), 54–68, quotation at 59.
24 Ibid.
25 Ibid., 65.
26 *Athenaeum*, vol. 2 (1834), 6.
27 David Brewster, 'Review of *On the Connexion of the Physical Sciences*', *Edinburgh Review*, vol. 59 (1834), 154–71, quotation at 155.
28 Ibid., 155–56.
29 Ibid., 159.
30 Secord, 'Introduction', xiv.
31 *The Saturday Magazine*, vol. 10 (September 1837), 118.
32 *The Penny Magazine*, vol. 6 (May 1837), 191–92. The *Penny Magazine* was founded by Charles Knight under the auspices of the Society for the Diffusion of Useful Knowledge and reached a peak circulation of 100,000.
33 Picker, *Victorian Soundscapes*, 10; see also Sterne, *The Audible Past*, 2–3 and 41–45.
34 See Neeley, *Mary Somerville*, 101–29; Secord, 'Mathematics for the Million?', 124–25.
35 Pesic, 'Thomas Young's Musical Optics', 29.
36 Maria Edgeworth, letter to Mary Somerville, 31 May 1832, in *Personal Recollections, from Early Life to Old Age, of Mary Somerville*, ed. Martha Somerville (London: John Murray, 1873), 204.
37 Secord includes a table listing the publication history of *Connexion*, including the number of copies printed and their prices, in 'Introduction', x.
38 Sterne, *The Audible Past*, 33.

39 Arabella Buckley, *The Fairy-Land of Science* (London: E. Stanford, 1880), 124–49.

40 In *The Audible Past: Cultural Origins of Sound Reproduction* (2003), Jonathan Sterne is explicit about his bias towards 'hearing elites' in documenting the history of sound: 'My emphasis on the very early moments of technologies and practices at times leads me to concentrate on a relatively small, elite (white, male, European or American, middle-class, able-bodied, etc.) group of people ... [I focus] on hearing elites because they provide a wealth of documentation about the meaning of sound and listening – *qua* sound and listening – on which to build a study.' *Audible Past*, 28.