ZGMTH Zeitschrift der
Gesellschaft für Musiktheorie

Steege, Benjamin (2010): Music Theory in the Public Sphere. The Case of Hermann von Helmholtz. ZGMTH 7/Sonderausgabe [Special Issue], 9–30.
https://doi.org/10.31751/557

veröffentlicht / first published: 01/11/2010
zuletzt geändert / last updated: 16/10/2010

Music Theory in the Public Sphere

The Case of Hermann von Helmholtz

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The musical writings of Hermann von Helmholtz are often read as the epitome of a high-technical sophistication enabled by intense investment in German experimental science after 1850. But an overlooked, contrasting aspect of these texts' historical significance should be acknowledged: namely their intended status as popular science. Helmholtz's attempt to ground modern harmonic practice in the empirical 'sensations of tone' was arguably the first (and conceivably the last) work of such ambitious scope that was explicitly aimed not merely at an elite musical community, but at a wider public. This article explores the implications of a historical popular-scientific agenda for music theory and proposes that music theory's popularization effectively altered its very object.

Die musikalischen Schriften von Hermann von Helmholtz gelten als Inbegriff eines technisch anspruchsvollen Diskurses, der seine Existenz der rasanten Entwicklungen der experimentellen Wissenschaften verdankt. Häufig übersehen wird dabei ein Aspekt, der dazu kontrastiert, für die historische Bedeutung dieser Texte aber betont werden muss: der Umstand, dass sie als populäre Wissenschaft intendiert waren. Helmholtz' Versuch, die Harmonik der zeitgenössischen Musik aus den empirisch fassbaren ›Tonvorstellungen‹ herzuleiten, war wohl der erste (und mit Sicherheit der letzte) ambitionierte Versuch dieser Art, der sich nicht nur an eine musikalisch gebildete Elite richtete, sondern an eine breite Öffentlichkeit. Der Artikel erkundet die Auswirkungen eines solchen populärwissenschaftlichen Ansatzes für die Musiktheorie und zeigt, dass die Popularisierung der Musiktheorie ihren Gegenstand veränderte.

One tends to assume that music theory is written for the benefit of other music theorists, that producers of the discourse constitute their own audience, and that this more or less closed circle of writers and readers admits no entrance from, or outlet to, an exterior. There has long been a legitimate question as to whether music theory has or needs a public. At best, distilled codifications of professional discourse are occasionally published as textbooks, which nevertheless call out for the guidance and interpretation of trained practitioners, and never approach anything like the ostensibly general interest of, for example, popular physics or 'pop psychology.' In short, unlike many other codes of academic knowledge, music theory rarely seems to require a sustained engagement with what we might call, for lack of a better term, the 'public sphere' – that elusive and problematic space between the state and the private sphere, which Jürgen Habermas long ago characterized as a universally accessible but historically fleeting "realm of our social life in which something approaching public opinion can be formed."[1]

Yet there have been scattered historical moments when the will to address a non-specialist readership has sprung rather suddenly into effect. Why the impulse to popularize occurred when it did, and what implications an altered mode of address may have had, are central questions for this essay. I focus here on a single case study: that of physicist and physiologist Hermann von Helmholtz (1821–1894), a figure whose efforts to ground the theory of 'modern' harmony in contemporary scientific knowledge must be interpreted as part and parcel of a wider effort to render that knowledge public. Indeed, Helmholtz – and, later, Ernst Mach, a younger colleague who worked to popularize Helmholtz's project in Vienna and Graz in the early to mid-1860s – belonged precisely to the historical moment and social milieu that came perhaps closest to realizing Habermas' idealistic retrospective vision of the public sphere: liberal bourgeois academe of mid-nineteenth-century Western and central Europe (however demographically limited indeed this milieu may have finally been).[2]

Though Habermas construed the emergent bourgeois public sphere first and foremost as enabling a critical function in relation to state power, it is important to acknowledge that the critical aspect of the new public discourse also operated in less 'high political' contexts, including literature, or, more germane to the present case, the cultivation of new forms of knowledge and the textual genres that support them. From early on constrained by a Prussian military-cultural upbringing that disabled open political critique, Helmholtz rarely discussed politics publicly (nor even in private correspondence), though his social interactions consistently suggest like-mindedness with the progressive academics he associated with.[3] Yet, as numerous historians of science have argued, participation in shaping a new political environment readily took forms other than outright speech for German scientists in Helmholtz's milieu. Bernhard vom Brocke, David Cahan, and Timothy Lenoir, among others, have affirmed that for moderate liberal intellectuals in the wake of the post-revolutionary reaction of the 1850s, a forced retreat to the relatively protected and seemingly innocuous environment of experimental science should not be interpreted simply as a resignation from the political sphere altogether, but rather as allowing a shift of leverage to a new strategic position. As Lenoir and Cahan in particular have argued, the goal of reforming (and later nationalizing) natural scientific education clearly meshed with the interests of new entrepreneurial classes and could be synchronized with the national-liberal aspirations of economic and social progressives alike.[4] Cahan maintains that Helmholtz's views were "essentially those of that amorphous

1 Habermas 1974, 49.

2 According to the outline familiar from Habermas' influential *Habilitationsschrift*, the "bourgeois public sphere" is understood to have emerged over the course of the eighteenth century (first in Great Britain and France, somewhat later in Germany) as a metaphorical space characterized by, among other things: the private takeover of the press from the monarchy (though in service of public interests), intensified association of private citizens for the purpose of debate (for example, in coffee houses and salons), and, most broadly, an increasingly prominent role for "people's public use of their reason" in the context of "rational-critical public debate" (*öffentliches Räsonnement*). Habermas 1962, 38–39, 1989, 27–28.

3 On Helmholtz's politics generally (and the difficulties in assessing them), see especially Brocke 1996.

4 Cahan 1993a and Lenoir 1997a.

and multifaceted (if not contradictory) nineteenth-century phenomenon known as German liberalism." As "a true German Kulturträger … and arguably a mandarin member of the German academic elite," Helmholtz would thus have been "one of the leading figures in shaping and modernizing that elite's understanding about the relations of scientific, socioeconomic, and political life."[5]

It was in this context that the relatively new genre of popular-science writing assumed a significance beyond simply educating the public about the aims and activities of modern scientists; rather, as Kurt Bayertz has suggested, it sought to enroll public interest in the broader potential that science and technology offered for modernizing and unifying German lands still viewed by many as 'backward' in comparison with France and England.[6] Both Helmholtz and Mach cultivated the persona and responsibilities of the public intellectual who sought to align an otherwise narrow disciplinary agenda with the broader interests of a German-speaking population anticipating a nationally unified parliamentary democracy. And both not only helped quicken the pace of interdisciplinary exchange within the university but also saw the project of converting academic knowledge into public knowledge as essential to their professional calling. Thus, their efforts at, first, formulating music theory on a modern scientific basis, and, second, disseminating it in popular form can only be fully understood as part of this larger agenda of progressive reform.[7]

The first sentence of Helmholtz's landmark treatise on sound and music, *Die Lehre von den Tonempfindungen als physiologische Grundlage für die Theorie der Musik* (1863), enacts an obligatory gesture of "laying the fruits of an eight-year labor before the public."[8] His nod to that abstract entity, *die Öffentlichkeit*, though perhaps cliché within the rhetorical function of any preface, nonetheless already indicates a significant, though often overlooked, register of Helmholtz's work.[9] The implications of Helmholtz's explicitly addressing this new cultural force need to be evaluated in some depth, with special attention to the role of the relatively new textual genre of popular science in this period. This was not a straightforward proposition, however; I mean to suggest that bringing

5 Cahan 1993a, 561.

6 Bayertz 1985.

7 It should be noted that Helmholtz (like Mach) approached the discourse of music theory as an outsider, possessing neither professional credentials from any musical institution nor a practical engagement with some active musical community. Yet, at least partly because of Helmholtz's central role in both the early and the late writings of Hugo Riemann, it became difficult to approach speculative questions in theory without grappling with the consequences of his work. See, for example, Riemann 1882. For Carl Dahlhaus, Helmholtz's was "the only work that actually proved 'epoch-making' in nineteenth-century music theory, influencing practically everyone from the philosopher pondering the problems of aesthetics to the humble musician teaching how to write chord progressions." Dahlhaus 1989, 192–93.

8 Helmholtz 1863, v.

9 To be sure, Jean-Philippe Rameau, perhaps closest to Helmholtz in his zeal to join contemporary acoustical theory with a musician's understanding of common-practice harmony, had also dedicated his *Traité de l'harmonie* of 1722 "to the Public" (*au Public*). Rameau 1722/1983, no page number. Yet it hardly needs to be said that the 'public' of Rameau's era (decades before the Revolution) was nothing like that of Helmholtz's. For case studies of the structure and function of the 'public sphere' in each context, see Bell 1992 and Eley 1992.

together the generic prerogatives of popular science and music theory essentially altered the latter's goals and image. Indeed, between roughly 1860 and 1880, the short-lived project of popularizing a 'scientific' music theory generated an odd discursive paradox: at the same time that these writers were broadening beyond the usual restricted musical readership, their objects of study tended to become increasingly narrow, even marginal. As attention shifted away from the ostensibly primary concerns of more practice-oriented music theory like harmonic progression and compositional poetics, and toward things like upper partial tones, combination tones, and acoustic beats, a battery of new observational techniques emerged, appropriate to these unfamiliar 'objects.' This quasi-dialectics of scale or scope thus resulted in unprecedented modes of perception that involved both a kind of 'deskilling', in the spirit of popularization, and also an intense specialization of hearing.

In the following, I first explore further the academic and social-political context in which the popularization of science took root in Germany. Focusing on the special genre of speculative 'scientific' music theory Helmholtz forged around 1860, I suggest that the complementary broadening and narrowing tendencies of this discourse were effects of systemic changes in the circulation of knowledge. In this context, increasing disciplinary specialization in the academy was met in kind by a redoubled impulse to reach across scholarly boundaries and resist disciplinary isolation. I then examine some of the ways in which the objects of this new branch of music theory demanded change in traditional listening habits. The restrictiveness and, from a musical point of view, relative decontextualization of this new aural regimen gave the lie to the notion of popularization as a neutral transmission of the status quo in knowledge. Rather, I suggest, in interpreting texts such as those of Helmholtz and Mach, we must attend to the intimate ways in which the nominal content of music-theoretical texts is shaped by the generic function of these texts – in this case, the popularization of scientific knowledge.

Popular science writing assumed its highly charged public function at precisely the historical moment when Helmholtz was most focused on the study of sound and music. This charge was felt especially keenly in Germany, where industrialization, and the concomitant rise in social prestige of experimental laboratory-driven science (as opposed to the more speculative work of *Naturphilosophie*, or of the *Naturforscher* persona), had not taken off as early and decisively as it had in England.[10] As a result, science writing intended for an educated but non-specialist audience could not but have excited keen interest, especially when it dealt with a topic as central to the formation of an emergent national identity as music was. It also generated a certain amount of anxiety. In 1867, Selmar Bagge, editor of the *Leipziger Allgemeine Musikalische Zeitung*, put his finger on a concern likely felt by many musicians when he observed the current market disadvantage suffered by publications on music, aesthetics, and theory in comparison with science texts.[11] A case in point was the lack of any call for a second edition of the 1853 harmony treatise, *Die Natur der Harmonik und der Metrik*, by the Leipzig pedagogue,

10 On the German context for these developments, see Bayertz 1985. The indispensable study is Daum 1998.

11 Bagge 1867, 165.

Moritz Hauptmann. In contrast, Helmholtz's more recent *Tonempfindungen*, which drew heavily at times on Hauptmann and was arguably just as specialized in subject matter (perhaps even more so), had already met with great success: two years after the first edition of 1863, the second edition came out with minimal alterations, and a French translation (*Théorie physiologique de la musique, fondée sur l'étude des sensations auditives*, trans. Georges Guéroult) appeared in 1868. Any apprehensions about the relative 'value,' in market terms, of traditional music theory in comparison with natural science would only have intensified when Helmholtz published a revised third edition in 1870 and a fourth, heavily revised, in 1877. Meanwhile, a widely read English translation (*On the Sensations of Tone as a Physiological Basis for the Theory of Music*, trans. Alexander J. Ellis) appeared in 1875, itself warranting a revised second edition by 1885.

More threatening to the production of traditional music theory than sheer sales numbers, however, was the generic potential of natural science texts to be *popularized*. The phenomenon of science popularization at this time was both a social effect and a textual one. A robust scientific culture in Germany and Austria was sustained by a more or less cohesive community of workers who had managed to develop vital lines of communication and cooperation throughout the German states, allowing them to address a relatively broad and receptive public and, vitally, to bend the ears of the various regional ministries of culture and education. In the project of communicating the value and interest of their work to the public, then, scientists tended to enjoy certain structural advantages over the traditional, often guild-like and easily isolated groups of German musicians, who were only rarely attached to state universities, with the attendant social power and prestige those institutions offered.[12] With this in mind, it is not difficult to understand why Bagge worried about the shifting cultural status of musical scholarship and publication when he wrote, still comparing Hauptmann and Helmholtz:

> Bei der aber beiden bis auf einen gewissen Grad gemeinschaftlichen Eigenschaft des Abstracten, wird man sich nicht wundern, wenn von Verehrern und Kunst- oder Wissenschaftsgenossen der Versuch gemacht wird, die Lehren ihrer Meister zu popularisiren, sie durch Befreiung von der Wucht der Zahlen oder Rechnungen einerseits, und von der Schwierigkeit der Begriffsformeln andererseits Jenen zugänglicher zu machen, die sich von diesen Dingen abgeschreckt fühlen. Auch in dieser Beziehung ist bis jetzt Hauptmann's Buch im Nachtheil geblieben, denn das einzige derartige Unternehmen … ist ziemlich unglücklich ausgefallen und hat nicht vermocht, Hauptmann verständlicher und populärer zu machen. Dagegen rührt man sich in den Kreisen der Physiker, Akustiker und Physiologen ausserordentlich, um das von Helmholtz urbar gemachte Feld weiter zu bebauen und neue Frucht daraus zu gewinnen. Auch dies ist begreiflich,

12 A. B. Marx's appointment to the University of Berlin in 1830 had been one of the first prominent appointments of its kind and such positions remained rare for music scholars until the end of the century. On the professional and social organization of German scientists, see Turner 1971 and McClelland 1980, esp. ch. 5, "The professoriate and the research ethic, 1819–1866," 162–89. By John Deathridge's account, it would seem that the closest answer musicians had to the more venerable and cohesive professional associations of German scientists were the many music societies and voluntary associations (*Gesellschaften* and *Vereine*), which sprouted up in German cities in the 1850's. Such associations would have "crystallized" "the aspirations of the educated and propertied bourgeoisie, its family, personal and socialties … at an informal, non-corporatist level." Deathridge 1991, 56.

> denn unter den Musikern, die doch Hauptmann's Buch vor allen zu lesen und zu verstehen im Stande sein sollen, finden sich bei weitem weniger wissenschaftlich fähige und vorbereitete Köpfe als unter den Jüngern der positiven oder exacten Wissenschaften. Auch widerstrebt die philosophische Anschauungsweise einer Popularisirung weit mehr als die naturwissenschaftliche.[13]

Despite the suggestion here that Helmholtz's initial prose style or presentation made his work inaccessible, Helmholtz had in fact conceived *Die Lehre von den Tonempfindungen* as a popularization of more specialized work. Other than an 1857 lecture for non-scientific audiences, "Ueber die physiologischen Ursachen der musikalischen Harmonie," and a pair of brief lectures on musical topics in 1860 and 1862, all of Helmholtz's early acoustical writings had been intended for a narrow circle of specialists and would have appeared forbidding in the density of their mathematical content.[14] The publication of the *Tonempfindungen* in 1863, then, was meant as a significant transformation in his mode of address. In 1860, Helmholtz explained to a colleague: "Ich habe mich daran gemacht, meine akustischen Arbeiten zusammenzuschreiben; es soll daraus ein kleines Buch *von möglichst populärer Haltung* werden, um es auch den Musikliebhabern zugänglich zu erhalten, weil ich meine, auch die physikalisch-physiologische Begründung der Harmonielehre darin niederlegen zu können."[15]

By the early 1870's, various *further* popularizations of Helmholtz's work on sound and music had already superseded any question about the 'popular' qualities of the *Tonempfindungen* itself. Helmholtz found an unsolicited ally in the zealous young Viennese physicist Mach, who sought to win over Vienna's educated public to an appreciation of the value of attentiveness to aural sensation with *Zwei populäre Vorlesungen über musikalische Akustik* (1865), and a short monograph, *Einleitung in die Helmholtz'sche Musiktheorie, populär für Musiker dargestellt* (1866).[16] In London, meanwhile, the well-known physicist, John Tyndall, gave a series of public lectures, published as *Sound*

13 Bagge 1867, 165. Bagge is referring to a work by Hauptmann's friend, Louis Köhler: Köhler 1858.

14 Helmholtz 1884, 79–115. The bulk of Helmholtz's other writings on acoustics are collected in Helmholtz 1882, 233–428 (on "Schallbewegung"); Helmholtz 1883, 503–588 (on "Physiologische Akustik"), and Helmholtz 1895, 7–9 (a single short paper, "Ueber die Combinationstöne oder Tartinischen Töne"). These writings ranged from non-specialized talks delivered at local society meetings such as that of the *Naturhistorisch-medicinischer Verein zu Heidelberg* to publications on 'pure' physics for acousticians.

15 Helmholtz, letter to Francisus Cornelis Donders, 1860. Emphasis added. Quoted in Koenigsberger 1902, 360. A few months before *Die Lehre von den Tonempfindungen* was completed, Helmholtz's wife, Anna, wrote to her aunt in Paris describing the pains her husband took to ensure that an educated but non-scientific reader could follow his argument: "Il y a beaucoup de mathématiques dans le livre, mais il y a des chapitres écrits pour tout le monde et surtout pour les musiciens—il m'en fait la lecture, et si je ne comprends pas quelque chose—il change le paragraphe jusqu'à ce que je sois à-même d'y voir clair." Anna von Helmholtz, letter to her aunt, Mary von Mohl, in Paris, January 1, 1862. Quoted in Siemens-Helmholtz 1929, 102.

16 Mach 1865, Mach 1866. The two lectures presented the topics of "the fibers of Corti" (in other words, the auricular apparatus and its relation to the sensation of tone), and "the causes of harmony," which amounted to a condensed overview of Helmholtz's physiological theory of consonance. Mach also incorporated elements of his early Helmholtz popularizations in Mach 1886, his better-known study on the "analysis of sensations."

(1867), which addressed the specifically acoustical (i. e., non-musical) aspects of Helmholtz's work.[17] And the 1870's saw an acceleration in English popularizations, including Sedley Taylor's *Sound and Music: An Elementary Treatise on the Physical Constitution of Musical Sounds and Harmony* (1873), whose subtitle further characterized it as "including the Chief Acoustical Discoveries of Professor Helmholtz"; and William Pole's *The Philosophy of Music* (1879), which was intended to "give some account of" the theory and aesthetics of music "as established by the investigations of Helmholtz."[18] All three English books, as well as English translations of Helmholtz's and Mach's popular lectures on acoustics, came out in multiple consecutive editions, bearing witness to the robust Victorian market for popular acoustics in a Helmholtzian vein through the turn of the century. Such textual accumulation testifies to contemporary commitment to the transformative value of science in public culture, which Helmholtz himself described as a historically imperative "striving toward popularization" in his introduction to the German edition of Tyndall's *Fragments of Science* (translated by his wife, Anna von Helmholtz).[19]

Seen against this peculiarly modern 'striving' for a middle class empowered by scientific education, *Die Lehre von den Tonempfindungen* must be evaluated as a special moment within a broader pattern of capitalizing on invigorated public curiosity about scientific praxis and the scientific persona. Seeking to enroll the interests of an ascendant bourgeoisie in the labor and cultural milieu of modern science, as Lenoir and others have shown, Helmholtz had embarked on a campaign to renovate the circulation of knowledge. In a century whose educational institutions and ideals in Germany had until then been overridingly shaped by the neohumanist program outlined by Wilhelm von Humboldt – a program which "had the study of language at its center," in Helmholtz's assessment – a particular subculture of younger academics like Helmholtz was advocating a radically new tack in the university, as in the life of the public at large. In this context, the growing symbolic capital of popular science was seen as a means to loosen the monopoly on academic and cultural authority purportedly held for decades by scholars in the *Geisteswissenschaften*, and to propose a more formative role for natural sciences in shaping the national state desired by German liberals.[20] In his preface to Tyndall's *Fragments*, Helmholtz argued that popular science at its best went beyond "fishing for a new kind of entertainment or for empty and fruitless curiosity," but instead constituted "a well-justified intellectual need that closely correlates with the most important mainsprings of contemporary intellectual developments." He continued:

> Nicht dadurch allein, daß sie gewaltige Naturkräfte den Zwecken des Menschen unterworfen und uns eine Fülle neuer Hilfsmittel zu Gebote gestellt haben, sind die Naturwissenschaften von dem allererheblichsten Einfluß auf die Gestaltung des gesellschaftlichen, industriellen und politischen Lebens der zivilisierten Nationen geworden; und

17 Tyndall 1867.

18 Taylor 1873, Pole 1895, 9.

19 This introduction has been reprinted as an independent essay: Helmholtz 1971. Originally published in Tyndall 1874.

20 For a compelling overview of how these aspirations were formed in the turbulent years around 1848 and gradually realized by the early 1870's, see Lenoir 1997.

> doch wäre schon diese Art ihrer Wirkungen wichtig genug, daß der Staatsmann, Historiker und Philosoph ebensogut wie der Techniker und Kaufmann wenigstens an den praktisch gewordenen Ergebnissen derselben nicht teilnahmlos vorübergehen kann. Viel tiefergehender noch und weiter tragend, wenn auch viel langsamer sich entfaltend, ist eine andere Seite ihrer Wirkungen, nämlich ihr Einfluß auf die Richtung des geistigen Fortschreitens der Menschheit. Es ist schon oft gesagt und auch wohl den Naturwissenschaften als Schuld angerechnet worden, daß durch sie ein Zwiespalt in die Geistesbildung der modernen Menschheit gekommen sei, der früher nicht bestand. In der Tat ist Wahrheit in dieser Aussage. Ein Zwiespalt macht sich fühlbar; ein solcher wird aber durch jeden großen neuen Fortschritt der geistigen Entwickelung hervorgerufen werden müssen, sobald das Neue eine Macht geworden ist und es sich darum handelt, seine Ansprüche gegen die des Alten abzugrenzen.[21]

Helmholtz did not specify precisely what sort of *Zwiespalt*, or "schism," he had in mind here. But we may infer that the split referenced not only a generational rift between modern empirical scientists and old-school interpretive humanists, but also the increasing separation of scholars in any field from those in all others, and the concomitant obsolescence of the authority of any individual intellectual to speak the truth about all subjects, for all scholars, to all audiences. It was critical for Helmholtz and others to demonstrate that the appearance of fragmentation, diversification, and specialization did not need to be assessed as hopelessly damaging to German culture and *Bildung*, even if these new developments did represent an acutely felt departure from the values of idealism, holism and universalism that had often been promised by the idealist vision of *Wissenschaft um ihrer selbst willen* in the first half of the century.[22] Indeed, Helmholtz's optimistic, redemptive view of the 'schism' in culture and knowledge represented by modern science had been beautifully forecast in an essay by the critic (and early Wagnerian), Richard Pohl, in the *Neue Zeitschrift für Musik* some ten years before the appearance of the *Tonempfindungen* and nearly twenty years before Helmholtz's manifesto on popular science in the Tyndall translation. Pohl's anonymous *Akustische Briefe* of 1852 and 1853 were prefaced by a distinctly unnostalgic farewell to the heroic era of system-thinking and of sweeping intellectual enterprises:

> Die Theilung der Arbeit, die Analyse ist das Charakteristische unserer Zeit, soweit sie sich mit der Materie beschäftigt. Die Kritik ist das Zeichen unserer Zeit auf intelectuellen [sic] Gebiete. Der Eintritt einer kritischen Periode beweist, daß die Production im Abnehmen begriffen, daß der Culminationspunkt überschritten ist. … Ein Jahrhundert endlich, das die Theilung der Arbeit im Materiellen und Intelectuellen anerkennt, kann die Universalität weder fordern, noch gestatten, selbst wenn sie sich bei der unendlichen Detailarbeit und Detailkenntniß nicht von selbst verbieten würde. Darum gehören die epochemachenden Productionen, die Synthese und die Polyhistoren, einer vergangenen Zeit an.[23]

21 Helmholtz 1971, 365–66.

22 For a range of perspectives on Helmholtz's hopes for popular science, see Cahan 1993a, Kant 1995, and Schickore 2001.

23 Anonymous [Pohl] 1852, 1–2. Original emphasis.

Given the ambivalent memories, at this time, of the totalizing philosophical aspirations of the *Vormärz* period – Hegelian and Schellingean academics were charged with the brunt of responsibility – Pohl's sentiment would have been wholly in line with a general tendency in the early 1850s to distrust any claims to universalism, and particularly claims based on essentially speculative knowledge. In a book for which Helmholtz expressed strong sympathy, the philosopher Rudolf Haym bitterly recalled those earlier decades of acute professional and philosophical constraints:

> wo man entweder ein Hegelianer, oder ein Barbar und Idiot, ein Zurückgebliebener und ein verächtlicher Empiriker war, – wo der Staat – man Denke! – sich nicht am wenigsten deshalb sicher und befestigt dünkte, weil der alte Hegel ihn in seiner Nothwendigkeit und Vernünftigkeit construirt hatte, und wo ebendarum es vor der preußischen Cultus- und Unterrichtsstelle beinahe als Verbrechen galt, Nicht-Hegelianer zu sein.[24]

In this climate of political and intellectual disillusionment with what Hermann Ulrici (another influential philosopher of Haym's generation) characterized as the "monarchical constitution" of totalizing philosophy, what was now celebrated instead was a kind of academic 'republicanism,' in which philosophical truth would be approximated through a heterogeneous 'system of systems' rather than the hegemony of a single system. Scholars and scientists were now called on to forsake solitary study in favor of the "common labor, the means to the solution of a common task."[25] A division of intellectual labor that encouraged robust disciplinary specialization was now believed to be the surest course between the Scylla and Charybdis of absolute Idealism and absolute Materialism, both of which ventured, in contrasting directions, beyond what they were able to present as certain knowledge.[26]

If an intensified division of labor, and a resurgent faith in empiricism, were widely perceived to be the signs under which modern German academics lived in the 1850's and 1860's, Mach opened his popular *Einleitung in die Helmholtz'sche Musiktheorie* of 1866 by observing a corollary or counter-movement to this increasing specialization. He found that the progressively more ramified order of knowledge resulted in a correspondingly accelerated rhythm of exchange among the disciplines, parallel to, and partly driven by, developments in the German economic situation:

> Materieller und geistiger Verkehr ist ein Zeichen unserer Zeit. Länder, die sich bisher ferngestanden, tauschen durch die Eisenbahnen ihre Producte aus und treten durch die Telegraphen in raschen Ideenverkehr. Wissenschaften, welche sich unabhängig von einander entwickelt, ja sich gewissermassen feindlich gegenüber gestanden haben, fangen an von einander Notiz zu nehmen, wechselseitig in einander unterstützend einzugreifen. Letztere Erscheinung dürfte wesentlich bedingt sein durch die gegenwärtige

24 Haym 1857, 4. Helmholtz sent a copy to his father, a respected German and classics teacher at the Potsdam Gymnasium. See Koenigsberger 1902, 333–34. (Koenigsberger mistakenly identifies the author's name as "Heyne.")

25 Ulrici 1847, 33–35.

26 These tendencies are documented in Köhnke 1991.

> Leichtigkeit des Verkehrs unter den Gelehrten mit Hilfe des gedruckten Wortes, und namentlich durch die zahlreichen wissenschaftlichen Zeitschriften.[27]

In short, if a marked narrowing of scientific expertise was radically reshaping the university as well as the patterns of public circulation of knowledge, a younger generation was now seizing the opportunity to make a virtue of the new specialization by recognizing their individual roles as vital pieces of a larger national effort.[28]

This impulse toward solidarity among the professoriate becomes all the more understandable in view of the political climate in contemporary German universities. Academic Heidelberg in the years around 1860, for example, was the scene of a certain lingering siege mentality among moderates and liberals still wary of the firm reactionary hand of the Badenese state following the revolutionary years of the 1840s. According to the account of influential liberal statesman and legal scholar Robert von Mohl, who was also Helmholtz's father-in-law, the atmosphere in Heidelberg was particularly toxic after 1853, when their friend and colleague, the historian Georg Gottfried Gervinus, was charged with high treason for progressive views expressed that year in his *Einleitung in die Geschichte des neunzehnten Jahrhunderts*.[29] Thus, a reaching-out across specialized disciplines, without violating their boundaries, was perceived as a way of strengthening the political leverage of the professoriate. As von Mohl recalled of this period, Helmholtz acted on the privilege of free association with like-minded colleagues on a daily basis. "Es war damals," Mohl wrote in his memoirs, "ein wirklich seltener Kreis von geistig bedeutenden Männern versammelt, dessen Mittelpunkt durch eine Anzahl von Professoren der liberalen Partei gebildet war," including Helmholtz, Gervinus, as well as other equally prominent physicists, chemists, doctors, lawyers, and so on.[30] That such associations went beyond 'mere' social enjoyment and pointed toward the formation of politically significant alliances is everywhere evident in interpersonal communications of the period. Social, personal, and professional interactions were by no means strictly differentiated, and merged freely into exactly the kind of social space Habermas identified as giving the bourgeois public sphere its peculiar critical-political potential. Read, for example, an 1858 letter in which the philosopher Haym hopes that professional collaboration on popular scientific articles, which Helmholtz had been asked to write for Haym's influential *Preussische Jahrbücher*, might lead to a more general solidarity in the liberalization of national culture and political affairs:

27 Mach 1866, 1.

28 If positive evaluations of specialization were somewhat novel in Germany, a utopian vision of divisions of intellectual labor on Adam Smith's classical model had been fostered decades earlier in England by Charles Babbage, among others. See his discussion of the division of "Mental Labour" in Babbage 1832, 131–163.

29 Gervinus 1853. For a first-hand account of the mood among the moderate-liberal Badenese professoriate following Gervinus' indictment, see Mohl 1902, 227–28.

30 Mohl 1902, 225–26. Mohl's description of this milieu will resonate strongly for anyone familiar with Habermas' classic accounts of the historical role of coffee houses, *Tischgesellschaften* and other forms of association crucial to the political efficacy of the public sphere. See Habermas 1962, 41–55; 1989, 31–43.

> Wenn zwei Männer von ganz verschiedener wissenschaftlicher Beschäftigung sich auf dem Punkt begegnen, wo ihr Denken u. Gesinntsein zusammenstösst, so dürfen sie sich billig des Gesprächs freuen. Möchte ein solches Colloquium ein günstiges Vorzeichen für das Gelingen der Allianz sein, deren Abschluss diejenige Generation erleben wird, welche sich eines freieren Staats- u. eines gesünderen Nationallebens erfreuen wird als die unsrige.[31]

Helmholtz himself celebrated the new division of labor, characterizing the academic work force in 1862 as "an organized army, laboring on behalf of the whole nation, and generally under its direction and at its expense." Endeavoring "to augment the stock of such knowledge as may serve to promote industrial enterprise, to increase wealth, to adorn life, to improve political organization, and to improve the moral development of individual citizens," Helmholtz emphasized, any single individual, no matter how narrow their contribution, "must rest satisfied with the consciousness that he too has contributed something to the increasing capital of knowledge."[32] It is worth noticing how pointedly Helmholtz specified, nearly a decade before Germany's actual political consolidation, that this "increasing capital of knowledge" was the asset of a *national* entity.

The 'popularization' of science, then, would serve as a tool of national unification not only to the extent that it contributed to the "moral development of individual citizens," but also, perhaps more directly, insofar as it functioned as an increasingly necessary mode of communication between scientists in widely differing fields of academic labor. If the national 'army' of scholars was to operate effectively, the various branches would need to be able to communicate not just with their nearest colleagues but also within an expanding network of possible academic and public discourses.[33] In the case of the *Tonempfindungen*, Helmholtz sought to interest not only musicians and that amorphous construction we call 'the public,' but also instrument-builders, acousticians, physicists, physiologists, phoneticists, linguists, philologists, historians, classicists, aestheticians, and perhaps even the odd philosopher. Moreover, while the book was self-evidently written by a single person, its very possibility as an intellectual project was clearly conditioned by the collective labor of that same assortment of diverse individuals.[34] Given the imperative to fortify lines of communication within the academic community for the sake of its robustness as a national force, a book like the *Tonempfindungen* might almost have been justified solely on the merits of its engaging the interests of such a wide range of

31 Haym, letter to Helmholtz, 1858(?). Printed in Hörz 1997, 346. As of 1866, the *Preussische Jahrbücher* were edited by the now better-remembered historian, Heinrich von Treitschke, at the time an adamant National Liberal (who, like Helmholtz and many others of his stripe, turned moderate conservative only toward the later 1870s).

32 Helmholtz 1971, 141–143.

33 On the role of popular science as a mode of communication among scientists under increasing specialization, see Bayertz 1985 and Whitley 1985. But compare Cooter and Pumfrey 1994.

34 For thorough exploration of the scientific-cultural contexts in which Helmholtz began working on acoustics, see Jackson 2006, Pantalony 2002, and Pantalony 2005.

citizens, demonstrating the interconnectedness of disparate fields and thus galvanizing the intellectual 'soldiery.'[35]

Yet to focus solely on the triumphal progressivism of such visions would be to ignore a fundamental problem, which, despite all efforts at popularization and despite the 'synthetic' qualities of his scholarship in the *Tonempfindungen*, confronted Helmholtz from the outset. This problem was how to give *value* to the basic substance of the work. Given the relatively widespread elementary understanding of physical acoustics among the early twenty-first century educated public, it is easy to forget that the sudden emergence of such objects into the public sphere was a historical event of considerable novelty in mid-nineteenth-century Germany. And indeed, although there is no question that musicians and scientists had been in various senses 'aware' of beats and overtones for centuries – whether in the experimental scientific practices of the seventeenth century and after, or in the changing practices of day-to-day musical performance over the centuries – it was a fundamental task of the *Tonempfindungen* to propose the combined conceptual, social, and physical spaces in which such objects might come to occupy a new position of unprecedented significance to modern culture and particularly to modern German society.

In the case of the *Tonempfindungen*, then, the project of popularization aimed to transform not only interest but also value. In particular, it was critical to propose that the key term, 'sensation' (*Empfindung*), should become the site of conceptual and perceptual negotiations that might alter not only its significance but also the way in which it was experienced. Helmholtz's awareness of this transformative operation frequently becomes unmistakable in the text, especially at moments when he finds himself positioning his work in relation to other scientists and musicians:

> Wir sind mit unserer Untersuchung hier zu einer Schätzung der Obertöne gelangt, welche von den bisherigen Ansichten der Musiker und auch wohl der Physiker ziemlich abweicht. … Man hat die Obertöne wohl gekannt, aber fast nur in einzelnen Klangarten, namentlich denen der Saiten, wo die Gelegenheit günstig war, sie zu beobachten; sie erscheinen aber in den bisherigen physikalischen und musikalischen Werken als ein vereinzeltes, zufälliges Phänomen von geringer Intensität, eine Art von Curiosum, welches man wohl gelegentlich anführte, um dadurch die Meinung einigermaassen zu stützen, dass die Natur schon die Construction unseres Duraccords vorgebildet habe, welches im Ganzen aber doch ziemlich unbeachtet blieb. Dem gegenüber müssen wir behaupten …, dass die Obertöne ein allgemeiner Bestandtheil fast aller Klänge sind. … Endlich hat man sie fälschlich für schwach gehalten, weil sie schwer zu beobachten sind, während im Gegentheil in einigen der besten musikalischen Klangfarben die Stärke der unteren Obertöne der des Grundtons nicht viel nachgiebt.[36]

The narrative of revaluation – a quasi-Brechtian 'refunctioning' or *Umfunktionierung* – is clear: having long been marginalized as "a kind of curiosity" (*eine Art von Curiosum*), the overtones will be radically repositioned to form the crux of a method that sought to pursue the implications of these previously unheard sensations as far as realistically possible.

35 Note that these claims need not refer to the content of the theory treatise per se, but pertain purely to the genre of the text in its immediate social setting. I address issues of content below.

36 Helmholtz 1863, 98–99.

'Music theory' for Helmholtz was little more than a series of pseudo-deductions from this sheer fact of ostensibly marginal sensations, moving progressively down toward the more familiar texture of current compositional practice. Though its later stages in the text of the *Tonempfindungen* resemble the traditional image of music theory quite closely, its primary characteristic remained an insistence on *making its premises publicly, empirically, available* – a distinction that set Helmholtz apart from other major nineteenth-century theorists, whom Carl Dahlhaus once characterized as "dogmatic" by comparison.[37] In this sense, the *empiricism*, for which Helmholtz is generally and justifiably known, must be understood as a tool serving the larger purpose of publicizing knowledge. If one of the primary characteristics of the bourgeois public sphere, on Habermas' terms, was precisely its stimulating a critical function of exercising the capacity for 'judgment,' it would seem that the fundamental empiricist impulse of the *Tonempfindungen* could only be in a relationship of mutual reinforcement with the new structure or experience of publicness.

Whatever one thinks of the subsequent logical steps by which Helmholtz proceeded to theorize modern harmony, that initial impulse to attempt such a renegotiation of scholarly and public interests at all must be acknowledged as a unique feature of Helmholtz's work in this period. Acoustic sensation was not something to be superseded once the business of authorizing one's speech in the discourse of music theory had been dispatched through statement of scientific fact.[38] Rather, for Helmholtz, sensation was converted into the charged object of an enormously fortified attention and observational effort. Indeed, the disposition of attention to tones and to the particularity of their sensory qualities could go so far as to reproportion the perceived intensities of a tone's upper partials in comparison to the fundamental. To call for renewed attentiveness to sound *as sound* – to listen with unprecedented strain and even skill – was, finally, to call for a change in the object of study itself.

Scholarly readings of *Die Lehre von den Tonempfindungen* often miss the insistence with which Helmholtz needed to convince his public that the overtones were not fantastical but real. His methods for demonstrating their objective presence, he emphasized, were designed to show that perceiving them was "no error of the imagination": "[D]iese Versuche können übrigens dazu dienen, zu zeigen, dass es keine Täuschung der Phantasie ist, wenn man die Obertöne hört, wie Leute zuweilen glauben, welche sie zum ersten Male hören. Denn man hört sie eben nicht, wenn sie nicht da sind."[39] Given the current state of general acoustical knowledge, it may seem odd that Helmholtz was so deeply invested in this apparently modest and preliminary task. And since musicians and scientists had been writing about such phenomena for more than a century before the *Tonempfindungen* was published, Helmholtz's lengthy demonstrations of the 'objective' presence of overtones might appear merely to recapitulate common knowledge. Yet,

37 Dahlhaus 1971, 49. For fuller consideration of problematics raised by the theoretical arguments of the *Tonempfindungen* in this connection, see Steege 2007, 147–223.

38 Even Hauptmann, who otherwise disdained the convention of discussing mathematics or acoustics at all, felt compelled to go into some detail, albeit idiosyncratically, about frequency ratios and the motions of the vibrating string at the beginning of Hauptmann 1853, 1–4, 19–21.

39 Helmholtz 1863, 92.

despite the availability of earlier publications exploring the overtone series as an object of music-theoretical interest, actual empirical *encounters* with such phenomena, and an appreciation for their music-theoretical value, were in fact extremely rare around 1860.[40] Helmholtz rightly assumed that many of his readers would not have any immediate reason to believe that upper partials existed at all. Further, even if Helmholtz and others could plausibly testify to the audibility of overtones and theoretically posit their physical causes, a widespread tendency persisted, from the era of Romantic science, to diagnose such marginal phenomena as 'subjective' or even 'pathological' if they could not be shown to be 'objective' (here, in the delimited sense of having a one-to-one correlation with physical events outside the listener's person). Thus, between 1863 and 1870, for example, a renewed interest in the perception of 'subjective tones' surfaced in clinical, pathological anatomy trade journals, betraying considerable anxiety about which acoustic perceptions were symptomatic of some illness and which were 'normal' to the extent that the sensations were 'objective.'[41]

In the face of such resistances, Helmholtz's various experimental acoustical apparatus, carefully designed to produce clear and audible simple tones, assumed a central role in the project of enabling public knowledge of obscure phenomena. It might even be said that Helmholtz sought not only to popularize knowledge or 'science' in the familiar sense, but rather also to popularize *sensation* itself. Helmholtz's concern went beyond merely demonstrating the 'objectivity' of the phenomena, as difficult as that often was in itself, to include the broader goal of creating accessible points of contact with them. Hence, one of the preoccupations of the *Tonempfindungen*, as well as of the various public demonstrations undertaken by Helmholtz, Mach, and others, was to present accessible experimental set-ups for making upper partials, beats, and combination tones readily perceptible. But such set-ups were not just a matter of observing natural processes unfold freely before the ears and eyes. Rather, because Helmholtzian modes of perception were predicated on the neutralization of habit and tacit knowledge, these set-ups entailed one's entering into a new aural perceptual discipline. In short, Helmholtz's immediate aim was above all to retrain the sensorium, to allow people to hear the familiar anew, as if for the first time.

The key demonstrations were devised to be easily reproducible by and for a broad audience. Most obvious among was Helmholtz's use of undamped piano strings as sympathetic resonators that rendered the single upper partials patently recognizable. As the quintessential sign of nineteenth-century middle-class cultivation, the piano was immediately available for refunctioning in the context of popular science education. At the same time, keyboard instruments familiar from the parlor were swiftly conscripted into service for experimental laboratories. "Nach dem heutigen Stande der Akustik sollte jedes gut dotirte physikalische Cabinet wenigstens ein Pianino und eine Physharmonika besitzen," asserted an 1865 catalogue of acoustic research apparatus, referring to a popular reed

40 Most familiar, of course, would have been the Rameau/d'Alembert theory of harmonic generation based on the series of audible harmonic overtones, which was kept alive in modified forms through the late eighteenth century via the Marpurg tradition and in the nineteenth century via François-Joseph Fétis' historical-theoretical writings.

41 Moos 1864, Moos 1867, Czerny 1867, Samelsohn 1869.

organ popular to a harmonium.[42] Such instruments, then, became mediating objects at a nodal point common to the private and public spheres, marking a unique locus that was strategically advantageous to a popularizing scientist.

The physharmonica made a special appearance in Mach's popular acoustics writings, where it formed part of a rigorous discipline of attending to the new acoustical objects of Helmholtzian music studies (upper partials, beats, and combination). A crucial chapter of the *Einleitung in die Helmholtz'schen Musiktheorie* argues for a perceptual discipline akin to what is called 'ear training' or *Gehörbildung* in contemporary musicianship classes, but which was virtually nonexistent at the time. "The systematic training of the hearing," he insisted, "is very important for every musician," but this "development of hearing is usually left to chance."[43] A reformed and buttressed aural attention was meant to guarantee the very "correctness and precision of perception."

> Bei jeder sinnlichen Wahrnehmung spielt die Uebung und die Aufmerksamkeit eine ungemein wichtige Rolle. Die Richtigkeit und Genauigkeit der Wahrnehmung hängt hiervon ganz wesentlich ab. … Das mehr oder weniger in der Anlage vorhandene musikalische Gehör kann durch Uebung und Aufmerksamkeit enorm entwickelt werden.[44]

Due to its sustained and predictable tone qualities, the physharmonica could be used, Mach showed, as an object for practicing a new way of hearing, in which one concentrated for extended periods of time on one sound in order to become capable of isolating individual elements within it, whether a single note in a chord or a single upper partial within a complex tone. Mach recommended specific aural exercises on the physharmonica that involved mentally linearizing chords and intervals that were in fact being physically sustained. For Mach, the fragmentary, elemental, and empirically constructed nature of the sensory world made it urgent to promote a certain perceptual vigilance: "Der Musiker muss hören lernen, wie der Maler sehen lernt."[45]

Equally strategic as the keyboard, and even more explicitly oriented toward the cultivation of new perceptual habits, were Helmholtz's spherical glass or brass resonators, which were conceived as means toward eliminating the special difficulties of attending to such unusual sounds. The resonator was intended to make obscure overtones and certain combination tones perceptible to an empirical investigator by amplifying through sympathetic vibration only a sounding tone of the specific frequency to which it was tuned. It demonstrated Helmholtz's point that such phenomena were first caused by precisely analyzable motions beyond the boundaries of an observer's aural apparatus. While built on simple technical principles, the resonator was more complex as a piece of social technology. Helmholtz seems to have viewed it as bearing a quasi-democratic, leveling capacity in that it rendered simple, even automatic, an action otherwise requiring great perceptual skill. Through its use, increasingly precise, if drastically narrowed,

42 Pisko 1865, 15.

43 Mach 1866, 25.

44 Mach 1866, 19–20.

45 Mach 1866, 22.

experiences of acoustic sensation became accessible beyond an elite circle of scientists, even to novices in empirical observation. These simple instruments brought unruly sound objects into easily manipulable, calibrated relations with one another, and they disseminated a limited set of observational skills through popular-lecture audiences and university acoustics lecture halls.

According to the Viennese scientist Franz Josef Pisko: "Durch Anwendung einer abgestimmten Reihe von Resonatoren kann ein *völlig musikalisch ungebildeter* und selbst *harthöriger* Forscher an akustischen Studien gehen, bei welchen einzelne *schwache* Töne, die durch eine Anzahl gleichzeitig auftretender stärkerer Töne verdeckt sind, wahrgenommen werden sollen."[46] With its particular efficacy in deskilling the fine labor of attention, Helmholtz insisted, a resonator rendered perceptible even sensations,

> zu deren Beobachtung sonst immer ein geübtes musikalisches Ohr oder eine sehr angestrengte und zweckmässig unterstützte Anspannung der Aufmerksamkeit gehört, weshalb auch bisher die genannten Phänomene nur der Beobachtung weniger Individuen zugänglich waren, und eine Menge von Physikern und selbst Musikern existirten, denen es niemals gelungen war, sie zu unterscheiden.[47]

Even for mid-century listeners already familiar with the general properties of musical sound, the resonators tended to produce a certain wondrous response, bearing witness to these instruments' ability to re-enchant the otherwise apparently banal material of music. Selmar Bagge described the scene at one of Georg Appunn's acoustical demonstrations in Leipzig in 1866 when the audience was encouraged to listen attentively for a tone's upper partials first without and then with Helmholtz's resonators:

> Für viele Besucher der Vorlesungen dürfte es ferner interessant gewesen sein, das Phänomen der Ober- und Combinationstöne mit leiblichen Ohren deutlich zu vernehmen. Das Mitklingen der Partial- (Ober-) Töne ist freilich eine so bekannte Erscheinung, dass die Scenen äusserst komisch waren, wo manche Zuhörer, selbst mit Resonatoren bewaffnet, dennoch eine Ungläubigkeit an den Tag legten, die dem alten Thomas nicht zur Unehre gereicht haben würde.[48]

The kind of attentiveness Helmholtz's resonators cultivated would enable anybody at all to perceive without special effort the overtones, combination tones, and beats, which – while, or perhaps because, they were normally unheard – were held to form the 'rational' basis for the nation's musical culture. The glass sphere, in all its novelty, cannot be separated from the changing public sphere, in all its novelty. However, the very notion of a public sphere entails a correspondingly critical understanding of the private sphere, from which it would be possible to open outward in the first place. The resonator's leveling of perceptual capability necessarily formed, at the same time, the intensely, narrowly 'private' experience that comes with hearing a single tone at a time, through an apparatus which seals off one's own perceptual sphere from that of others.

46 Pisko 1865, 7.

47 Helmholtz 1863, 75.

48 Bagge 1866, 118.

The modes of listening encouraged in the work of Helmholtz, and later, Mach – emblematized in the figure of the resonator – promised to put the ear back in contact with the raw materiality of simple sensations. Yet, of necessity, such instruments dramatically impoverished sensory experience. Meant to broaden the perceptual field by reactivating otherwise filtered sensory data, the resonator simultaneously entailed a narrowing of perception well beyond what was actually required for the purposes. What is true in the extreme of the resonator in particular was also true of listening in general, as it was constructed in the physiology laboratory by Helmholtz and others. A peculiar observational 'attention' was held up at every moment as a force of intentionality that would overcome countervailing mechanistic forces of perception. Yet this subjective intentionality, when itself made 'subject' to external discipline, immediately contracts into a funneled perception deprived of any intentionality or breadth at all. As was typical for experimental physiology and other practices in the decades after 1850, the more perception was posited as an active disposition directed by the free activity of the will, the more it seemed to take on the fixity characteristic of its own objects.

Indeed, such paradoxes increasingly fascinated researchers and philosophers between 1850 and 1900.[49] Yet, as I have attempted to indicate here, the problem was ultimately not simply one of abstract thought, but was a symptom of the broader difficulties musical discourse had situating itself within a culture of print capitalism, along with emergent genres like that of popular science, which promised the democratization of knowledge while finally preserving its specialization. If Helmholtz and Mach indeed remain key figures in the histories of science and music theory, as well as those of listening and of perception generally, then it would seem crucial not to exclude from view the textual and sociological categories entailed by such an analysis.

Helmholtz's project of transforming the interests and values attached to the music-theoretical endeavor was, I have suggested, a historical event of delimited scope and conditions. Helmholtz's dual persona as both a broad unifier of knowledge and a consummate specialist was a product of a specific moment in the history of the European university. It would appear, then, that another such project of publicizing or popularizing music-theoretical knowledge, discourse, and habits of thought is unlikely to recur. Indeed, one is hard-pressed to identify similar agenda even in the nineteenth or early twentieth centuries. François-Joseph Fétis' early text, *La musique mise à la portée de tout le monde*, was even more explicit than the *Tonempfindungen* about its 'popular' character but did not confine itself to theoretical concerns.[50] The eminently popularizing analytical and interpretive texts of a Hans von Wolzogen – as in the *Thematischer Leitfaden* publications of the 1870s and 1880s – or a Donald Francis Tovey – as in the *Essays in Musical Analysis* of the 1930s – might be loosely described as 'theoretical' yet made no pretense of laying bare for the public's critical judgment a set of quasi-systematic theoretical premises in the constitutive manner of the *Tonempfindungen*.[51]

49 Steege 2007, 126–46.

50 Fétis 1830.

51 For example, Wolzogen 1876; Tovey 1935–39. On Wolzogen, see Thorau 2003. Helmholtz's great admirer-*cum*-critic, Hugo Riemann, probably cannot be accurately described as engaging the same

In closing, then, it would unlikely be productive to inquire too optimistically about a relationship between today's music theory and some imagined public.[52] Though I have supposed here that *Die Lehre von den Tonempfindungen* was probably the only significant essentially music-theoretical document to be conceived self-consciously as a popular text, Helmholtz nevertheless still appears to have been less interested in publicly legitimating the claims of music theory *per se* than in representing – and perhaps 'domesticating' – the ethos and cultural relevance of experimental scientific inquiry. Beyond the obvious factor of his own somewhat defensive professional situation within an experimental discipline, was this because music theory, by its very nature, has always resisted publicization or popularization (as has philosophy, at least according to Selmar Bagge in 1867)? Or have opportunities been historically missed to present such claims to the critical judgment of an informed public?

It remains unclear today how well music theorists, at least in the United States, make the case for their continued relevance, even within the intellectual life of the university. As Richard Whitley argues, science popularization has often been at least as important in fostering communication among scholars in disparate fields as it has been in representing science to the non-academic public.[53] This conception of 'popularizing' music theory for the wider professional academic community, without sacrificing a specialist's rigor, has recently been instantiated by, for example, a series of music-theoretical articles in *Science* magazine, perhaps the most prestigious interdisciplinary nodal point for exchange among the 'hard' sciences.[54] But these articles, however representative of certain current trends in music theory, can hardly be said to essay a rationale for the discipline as a whole, and it is precisely such a rationale that remains enigmatic in both a public and an academic-political context. Despite the all but invisible place of music theory in public discourse (in comparison with, say, anthropology, neurology, or even theoretical physics), however, it at least remains for us as scholars and consumers of music theory – both historical and current – to attend critically to the varying modes of address adopted in deploying these texts within their various readerly fields. There is little sense in demonizing specialization, which, as the Helmholtz case demonstrates, by no means rules out, in itself, any and all good-faith efforts to communicate research and its values to a wider audience. But it remains worthwhile to read music-theoretical texts with an eye toward those mediated effects, however remote, that the public sphere as a kind of regulative

broad educated public as did Helmholtz, since even his various "catechisms" ultimately served a didactic function primarily for the music student, whereas Helmholtz also hoped to engage non-musicians. Popular mid-century books by prominent American public figures like Aaron Copland (1939) and Leonard Bernstein (1959) belong to the same category as Wolzogen and Tovey.

52 A defining aspect of Habermas' original study was the supposition that the public *critique* of knowledge and culture had given way, at some point between the nineteenth and twentieth centuries, to the public *consumption* of knowledge and culture. Habermas 1962, 176–92; 1989, 159–75. Any extension of my incipient and loose theorization here of some historical relationship between music theory and a public sphere would presumably need to take this hypothetical shift into account. Indeed, the very fact that one can apparently no longer speak intelligibly of a critical public engagement with music theory already hints at the aptness of Habermas' model for this context.

53 Whitley 1985.

54 Hook 2006, Tymoczko 2006, Callender et al. 2008.

ideal might exert upon them. Music theory may not 'need' a public, but to the extent that changing modes of address influence the making of music theory's very objects – as when Helmholtz's efforts to publicize theoretical knowledge generate an idiosyncratic emphasis on otherwise marginal phenomena – it certainly never remains immune to it, even at some remove.

References

Anonymous [Richard Pohl]. 1852. "Akustische Briefe, Erster Brief." *Neue Zeitschrift für Musik* 37.1 (July 2): 1–2.

Babbage, Charles. 1832. *On the Economy of Machinery and Manufactures*, London: Charles Knight, Pall Mall East.

Bagge, Selmar. 1866. "Ueber Herrn Appunn's Vorlesungen in Leipzig. Ein theoretischer Excurs." *Leipziger Allgemeine Musikalische Zeitung* 1.15 (April 11): 117–19

——. 1867. "Zur Theorie der Musik. Die Physiker und die Musiker." *Leipziger Allgemeine Musikalische Zeitung* 2.21 (May 22): 165–69.

Bayertz, Kurt. 1985. "Spreading the Spirit of Science: Social Determinants of the Popularization of Science in Nineteenth-Century Germany." In Shinn and Whitley 1985: 209–27.

Bell, David A. 1992. "The 'Public Sphere,' the State and the World of Law in Eighteenth-Century France." *French Historical Studies* 17.4: 913–14.

Bernstein, Leonard. 1959. *The Joy of Music*. New York: Simon and Schuster.

Brocke, Bernhard vom. 1996. "Hermann von Helmholtz und die Politik." In Eckhardt and Volkert 1996: 267–326.

Cahan, David (ed.). 1993. *Hermann von Helmholtz and the Foundations of Nineteenth-Century Science*. Berkeley: University of California Press.

——. 1993a. "Helmholtz and the Civilizing Power of Science." In Cahan 1993: 559–601.

Calhoun, Craig (ed.). 1992. *Habermas and the Public Sphere*. Cambridge, Massachussetts: MIT Press.

Callender, Clifton, Ian Quinn, and Dmitri Tymoczko. 2008. "Generalized Voice-Leading Spaces." *Science* 320, Issue 5874: 346–48.

Cooter, Roger, and Stephen Pumfrey. 1994. "Separate Spheres and Public Places: Reflections on the History of Science Popularization and Science in Popular Culture." *History of Science* 32, Part 3, no. 37: 237–67.

Copland, Aaron. 1939. *What to Listen for in Music*. New York: McGraw-Hill.

Czerny, Vincenz. 1867. "Ein Beitrag zur Kenntniss des subjectiven Hörens wirklicher musikalischer Töne." *Virchow's Archiv für pathologische Anatomie und Physiologie und für klinische Medizin* 41: 299–300.

Dahlhaus, Carl. 1971. "Hermann von Helmholtz und der Wissenschaftscharakter der Musiktheorie." In Zaminer (ed.) 1971: 49–58.

——. 1989. *Nineteenth-Century Music*. Translated by J. Bradford Robinson. Berkeley: University of California Press.

Daum, Andreas W. 1998. *Wissenschaftspopularisierung im 19. Jahrhundert. Bürgerliche Kultur, naturwissenschaftliche Bildung und die deutsche Öffentlichkeit, 1848–1914*. Munich: R. Oldenbourg.

Deathridge, John. 1991. "Germany: The 'Special Path'." In Samson (ed.) 1991: 56.

Eckhart, Wolfgang U., and Klaus Volkert (eds.). 1996. *Hermann von Helmholtz. Vorträge eines Heidelberger Symposiums anläßlich des einhundertsten Todestages*. Pfaffenweiler: Centaurus-Verlagsgesellschaft.

Eley, Geoff. 1992. "Nations, Publics, and Political Cultures: Placing Habermas in the Nineteenth Century." In Calhoun 1992: 289–339.

Fétis, François-Joseph. 1830. *La musique mise à la portée de tout le monde*. Paris: Mesnier.

Gervinus, Georg Gottfried. 1853. *Einleitung in die Geschichte des neunzehnten Jahrhunderts*. Leipzig: W. Engelmann.

Habermas, Jürgen. 1962. *Strukturwandel der Öffentlichkeit. Untersuchungen zu einer Kategorie der bürgerlichen Gesellschaft*. Neuwied/Berlin: Luchterhand.

——. 1974. "The Public Sphere: An Encyclopedia Article." Translated by Sara Lennox and Frank Lennox. *New German Critique* 3: 49–55.

——. 1989. *The Structural Transformation of the Public Sphere: An Inquiry into a Category of Bourgeois Society*. Translated by Thomas Burger. Cambridge, Massachussetts: MIT Press.

Hauptmann, Moritz. 1853. *Die Natur der Harmonik und der Metrik*, Leipzig: Breitkopf & Härtel.

Haym, Rudolf. 1857. *Hegel und seine Zeit. Vorlesungen über Entstehung und Entwickelung, Wesen und Werth der Hegel'schen Philosophie*. Berlin: Rudolph Gaertner.

Helmholtz, Hermann von. 1863. *Die Lehre von den Tonempfindungen als physiologische Grundlage für die Theorie der Musik*. Braunschweig: Vieweg und Sohn.

——. 1868. *Théorie physiologique de la musique, fondée sur l'étude des sensations auditives*. Translated by G[eorges] Guéroult. Paris: Masson.

——. 1875. *On the Sensations of Tone as a Physiological Basis for the Theory of Music* (2nd edition 1885). Translated by Alexander J. Ellis. London: Longman & Co.

——. 1882–95. *Wissenschaftliche Abhandlungen*. 3 vols. Leipzig: Barth.

——. 1884. *Vorträge und Reden*. Vol. 1. Braunschweig: Vieweg und Sohn.

——. 1884a. "Ueber die physiologischen Ursachen der musikalischen Harmonie." In Helmholtz 1884: 79–115.

——. 1971. *Philosophische Vorträge und Aufsätze*. Edited by Herbert Hörz and Siegfried Wollgast. Berlin: Akademie.

——. 1971a. "Über das Streben nach Popularisierung der Wissenschaft." In Helmholtz 1971: 365–78.

Hook, Julian 2006. "Exploring Musical Space." *Science* 313, Issue 5783: 49–50.

Hörz, Herbert. 1997. *Brückenschlag zwischen zwei Kulturen: Helmholtz in der Korrespondenz mit Geisteswissenschaftlern und Künstlern*. Marburg: Basilisken.

Jackson, Myles. 2006. *Harmonious Triads: Physicists, Musicians and Instrument Makers in Nineteenth-Century Germany*. Cambridge, Massachusetts: MIT Press.

Kant, Horst. 1995. "Helmholtz' Vortragskunst und sein Verhältnis zur populären Wissensvermittlung." In Krüger (ed.) 1995: 315–29.

Koenigsberger, Leo. 1902. *Hermann von Helmholtz*. Vol. 1. Braunschweig: Vieweg und Sohn.

Köhler, Louis. 1858. *Systematische Lehrmethode für Clavierspiel und Musik. Theoretisch und praktisch dargelegt* (= Musiklehre: Tonschriftwesen, Metrik, Harmonik 2). Leipzig: Breitkopf & Härtel.

Köhnke, Klaus Christian. 1986. *Entstehung und Aufstieg des Neukantianismus*. Frankfurt/Main: Suhrkamp.

Krüger, Lorenz (ed.). 1995. *Universalgenie Helmholtz: Rückblick nach 100 Jahren*. Berlin: Akademie.

Lenoir, Timothy. 1997. *Instituting Science: The Cultural Production of Scientific Disciplines*, Stanford: Stanford University Press.

——. 1997a. "Social Interests and the Organic Physics of 1847." In Lenoir 1997: 75–95.

Mach, Ernst. 1865. *Zwei populäre Vorlesungen über musikalische Akustik*. Graz: Leuschner & Lubensky.

——. 1866. *Einleitung in die Helmholtz'sche Musiktheorie, populär für Musiker dargestellt*. Graz: Leuschner & Lubensky.

——. 1886. *Beiträge zur Analyse der Empfindungen*. Jena: Fischer.

McClelland, Charles E. 1980. *State, Society and University in Germany. 1700–1914*. Cambridge: Cambridge University Press.

Mohl, Robert von. 1902. *Lebenserinnerungen*. Volume 1. Stuttgart/Leipzig: Deutsche Verlags-Anstalt.

Moos, Salomon. 1864. "Beitrag zur Helmholtz'schen Theorie der Tonempfindungen." *Virchow's Archiv für pathologische Anatomie und Physiologie und für klinische Medizin* 31: 125–26.

——. 1867. "Ueber das subjective Hören wirklicher musikalischer Töne." *Virchow's Archiv für pathologische Anatomie und Physiologie und für klinische Medizin* 39: 289–95.

Pantalony, David. 2002. *Rudolph Koenig (1832–1901), Hermann von Helmholtz (1821–1894) and the Birth of Modern Acoustics*. Ph. D. Diss., University of Toronto.

——. 2005. "Rudolph Koenig's Workshop of Sound Instruments, Theories and the Debate over Combination Tones." *Annals of Science* 62.1: 57–82.

Pisko, Franz Josef. 1865. *Die neueren Apparate der Akustik: Für Freunde der Naturwissenschaft und der Tonkunst*. Vienna: C. Gerold's Sohn.

Pole, William. 1895. *The Philosophy of Music, being the substance of a course of lectures delivered at the Royal Institution of Great Britain, in February and March 1877* (4th edition). London: Kegan Paul, Trench, Trübner & Co.

Rameau, Jean-Philippe. 1722. *Traité de l'harmonie reduite à ses principes naturels*. Paris. Reprint Geneva: Slatkine 1986.

Riemann, Hugo. 1882. "Die Natur der Harmonik." *Waldersee's Sammlung musikalischer Vorträge* 4: 159–90.

Samson, Jim (ed.). 1991. *The Late Romantic Era: From the mid-19th century to World War I*. Englewood Cliffs, New Jersey: Prentice Hall.

Samelsohn, Julius. 1869. "Zur Kenntniss des subjectiven Hörens wirklicher musikalischer Töne und Klänge. *Virchow's Archiv für pathologische Anatomie und Physiologie und für klinische Medizin* 46: 509–13.

Schickore, Jutta. 2001. "The Task of Explaining Sight – Helmholtz's Writings on Vision as a Test Case for Models of Science Popularization." *Science in Context* 14.3: 397–417.

Shinn, Terry, and Richard Whitley (eds.). 1985. *Expository Science: Forms and Functions of Popularisation* (= Sociology of the Sciences 9). Dordrecht/Boston: Reidel.

Siemens-Helmholtz, Ellen von. 1929. *Anna von Helmholtz: Ein Lebensbild in Briefen*. Vol. 1. Berlin: Verlag für Kulturpolitik.

Steege, Benjamin. 2007. *Material Ears: Hermann von Helmholtz, Attention, and Modern Aurality*. Ph. D. Diss., Harvard University.

Taylor, Sedley. 1873. *Sound and Music: An Elementary Treatise on the Physical Constitution of Musical Sounds and Harmony*. London: Macmillan and Co.

Thorau, Christian. 2003. *Semantisierte Sinnlichkeit: Studien zu Rezeption und Zeichenstruktur der Leitmotivtechnik Richard Wagners*. Stuttgart: Steiner.

Tovey, Donald Francis. 1935–39. *Essays in Musical Analysis*. 6 volumes. London: Oxford University Press.

Turner, R. Steven. 1971. "The Growth of Professorial Research in Prussia, 1818 to 1848 – Causes and Context." *Historical Studies in the Physical Sciences* 3: 137–182.

Tymoczko, Dmitri. 2006. "The Geometry of Musical Chords." *Science* 313, Issue 5783, 72–74.

Tyndall, John. 1867. *Sound: a course of eight lectures delivered at the Royal Institution of Great Britain*. London: Longmans, Green, and Co.

——. 1874. *Fragmente aus den Naturwissenschaften: Vorlesungen und Aufsätze*. Translated by Anna von Helmholtz. Braunschweig: Vieweg und Sohn.

Ulrici, Hermann. 1847. "Die wissenschaftlichen Tendenzen im Verhältniß zu den praktischen Interessen." *Zeitschrift für Philosophie und philosophische Kritik* 17: 24–36.

Whitley, Richard. 1985. "Knowledge Producers and Knowledge Acquirers: Popularisation as a Relation Between Scientific Fields and Their Publics." In Shinn and Whitley 1985: 3–28.

Wolzogen, Hans von. 1876. *Thematischer Leitfaden durch die Musik zu Richard Wagner's Festspiel der Ring des Nibelungen*. Leipzig: Schloemp.

Zaminer, Frieder (ed.). 1971. *Über Musiktheorie: Referate der Arbeitstagung 1970 in Berlin*. Cologne: Volk.