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Sound Knowledge: Music and Science in London, 1789-1851
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Engine Noise and Artificial Intelligence: Babbage's London

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[−] Abstract and Keywords

Williams describes Charles Babbage as he neared the end of his life: living on Dorset Street in Marylebone alongside an old Difference Engine and an incomplete Analytical Machine, one working automated dancer (purchased from the remnants of Merlin's Mechanical Exhibition, and restored), and – by Babbage's own furious account – many hundreds of noisy and disruptive street performers. Williams posits a connection between what he calls "Babbage's favored geriatric occupations": continued work on the Difference Engine, and a campaign for increased legal restrictions on "foreign" street musicians. Drawing on early designs for the Difference Engine, which required its operator to count the pealing of multiple bells, but also upon Babbage's pamphlet "On Street Nuisances" and his assertion that itinerant musicians had destroyed "one-fourth part of [his] working power," Williams supplies a chapter in the history of listening that emphasizes the labor value of silent audition. The author examines governmental measures to regulate street music for the furtherance of an "industrious" political economy, and assesses the role of audile technique in the development of disciplinary notions of mental labor and artificial intelligence.

Keywords: Charles Babbage, John Moulton, Difference Engine, London, artificial intelligence, street music, sound studies, history of listening, intellectual labor, noise

In 1914, a week before the guns of August, Baron Moulton of Bank delivered the inaugural address of the John Napier Society, founded in honor of its namesake, the sixteenth-century British inventor of the logarithm.[1] Napier's discovery, Moulton proposed, brought glory to his land, while also conferring more general benefits on humankind by increasing "the powers of the human mind as a practical agent." This he had achieved through speeding up arithmetical calculation: in 1614, exactly three centuries earlier, Napier published a landmark series of numerical tables that demonstrated how the multiplication of large numbers could be reconceived in terms of addition. Mulling the logarithm's significance for the history of science, Moulton wondered what had spurred Napier's insight. As a barrister deeply engaged in intellectual property, Moulton opted for a realist view: during his career at the Bar he had had the opportunity to notice the "circuitous" routes by which inventions were effected; Napier, like other innovators, had "groped in the dark" (for over twenty years) before perfecting his invention.[2] In the end he had emerged victorious—thereby demonstrating "the persistent effort of a great mind to perform a task which it has deliberately set to itself."[3] Everything depended on the eventual completion of that self-imposed mission: without the successful publication of his tables, the logarithm would have remained a scientific nonentity.

To underscore Napier's achievement, Moulton contrasted the fulfillment of an original goal with its opposite: with failure. In particular, he drew his audience's attention to the recent example of Charles Babbage's calculating engines. In the 1820s, Babbage began designing and constructing elaborate machines intended to compute, among other things, logarithmic tables. He was still sketching blueprints in the 1870s, during the final years of his life. It was around this time that Moulton, then an undergraduate math star at **(p.204)** Cambridge University, paid a visit to Babbage at his London residence, where he was given a tour of three domestic workrooms. The different spaces represented phases of the machine's development:

> In the first room I saw the parts of the original Calculating Machine, which had been shown in an incomplete state many years before and had even been put to some use. I asked him about its present form. "I have not yet finished it because in working at it I came on the idea of my Analytical Machine, which would do all that it was capable of doing and much more. Indeed, the idea was so much simpler that it would have taken more work to complete the Calculating Machine than to design and construct the other in its entirety, so I turned my attention to the Analytical Machine." After a few minutes talk we went into the next work-room, where he showed and explained to me the working of the elements of the Analytical Machine. I asked if I could see it. "I have never completed it," he said, "because I hit upon an idea of doing the same thing by a different and far more effective method, and this rendered it useless to proceed on the old lines." Then we went into the third room. There lay scattered bits of mechanism, but I saw no trace of any working machine. Very cautiously I approached the subject, and received the dreaded answer, "It is not constructed yet, but I am working on it, and it will take less time to construct it altogether than it would have taken to complete the Analytical Machine from the stage in which I left it." I took leave of the old man with a heavy heart.[4]

The calculating machine that Moulton remembered had been given another name by its inventor: the difference engine. By the mid-nineteenth century, it had become notorious as one of the earliest examples of public funds squandered in the pursuit of unintelligible science.[5] Beginning in 1823 with a grant of £1,500, Babbage received large subventions from the British Treasury, grants that continued sporadically until 1842—that is, until Babbage expressed his desire to abandon his early project in favor of starting work on his analytical engine. Understandably, the government was reluctant to write off the difference engine, which had already consumed so many funds. After seeking reassurances from the Royal Society, the Chancellor of the Exchequer granted Babbage one last payment—on condition that he strive to realize his original design. He grudgingly accepted the government's terms and applied renewed efforts to his (quietly modified) difference engine no. 2. But this project was similarly destined never to be finished.[6] By the end of the **(p.205)** 1840s, with no more money and with a working machine still a distant prospect, Babbage finally gave up. The British press lampooned the harebrained extravagance of an archetypal mad scientist.[7] As the *Morning Chronicle* put it, affecting sympathy with Babbage's frustrations:

> After twenty years' ceaseless labor of an intense description, together with an expenditure of a large fortune in hard cash, the whole undertaking was smashed—Mr. Babbage's hopes frustrated, besides his labor and money thrown away. It would be difficult to imagine a more bitter disappointment, the great work of a celebrated man's life suddenly reduced to a mere bagatelle.[8]

This public scandal lingered in the collective memory, at least until the eve of the First World War, when Moulton could revisit the story expecting his audience would remember the gist. In calling on distant memories, Moulton was passing on a myth—one that he elaborated through his private tour of the workrooms. According to his telling, each door revealed a greater horror: a progressively more ambitious machine aborted at an ever-earlier stage of construction. Like an aged Bluebeard, Babbage was haunted by these phantom love-objects lain to waste around his home: his property on Dorset Street in Marylebone had become a kind of sanctuary in which he could hold onto dreams of realizing his life's work.

Moulton's domestic psychodrama might give us pause, for it bears comparison with another urban legend associated with the Babbage household. It was from here that Babbage launched his campaign against "Street Nuisances"—the name given to his pamphlet-length tirade against organ grinders and itinerant brass band players, whom he targeted as prime social menaces and irritating polluters of the urban environment. As he put it in 1864:

> During the last ten years, the amount of street music has so greatly increased that it has now become a positive nuisance to a very considerable portion of the inhabitants of London. It robs the industrious man of his time; it annoys the musical man by its intolerable badness; it irritates the invalid; deprives the patient, who at great inconvenience has visited London for the best medical advice, of that repose which, under such circumstances, is essential for his recovery, and it destroys the time and the energies of all the intellectual classes of society by its continual interruptions of their pursuits.[9]

(p.206) At the time of its publication, Babbage's tract became well known within the context of a wider debate over a proposed law controlling street musicians. A key issue was the right to silence of the convalescent patient—or, more obviously, the Victorian male professional.[10] While there appeared to be a certain public-spiritedness about Babbage's complaint, his reference to general medical concerns and the needs of the industrious intellectual are disingenuous, belying his own carefully nurtured pet obsessions. He was much preoccupied by his own failing health; and, as one member of the self-proclaimed intellectual classes of society, he felt his time and energies were being dissipated by music coming from the street. Not content to suffer this assault in silence, during the 1850s and '60s he decided to confront these aggravations, advancing a strategic offensive against the noises of his neighborhood.

Taking my historical coordinates from this contested London topography, I explore the links between Babbage's favored geriatric occupations: between his ever-ongoing work on the difference engine on the one hand and his crusade against street musicians on the other. In his trenchantly anti-autobiographical autobiography (he deemed the genre too sedentary for a busy "philosopher"), Babbage hinted at an intimate connection between the two: "On careful retrospect of the last dozen years of my life, I have arrived at the conclusion that I speak within the limit when I state that one-fourth part of my working power has been destroyed by the nuisance against which I have protested."[11] Babbage's reference to the annihilation of intellectual work points to an unusual perspective on the issue of street music, and can begin to evoke for us his strained posturing vis-à-vis the sonic environment. In the pages that follow, I will try to elucidate his idiosyncratic views, and to use them as a vantage point from which to hear afresh the public and parliamentary debates over controlling London's street music in the 1860s. I hope ultimately to reassess musical activity in the city in the light of broader ideologies of progress—and its retardation—in the urban industrial-scientific economy. The mechanical wreckage at the elderly Babbage's home might serve (pace Moulton) less as a parable of scientific failure than as an allegory of progress's opposite: a negative force that bodied forth as street noise.

Matters of Difference

To understand what remained of the difference engine in Babbage's home in the 1860s, first we need to roll back the decades and try to recapture the vigor with which the invention burst on to the scientific scene. In June 1822, Babbage announced his discovery that the "method of differences" (I will return **(p.207)** to this term) could enable machinery to calculate astronomical tables; he claimed that a simplified working model had already been built.[12] At roughly the same time, he wrote a long, impassioned letter to Sir Humphry Davy, president of the Royal Society, explaining in detail the rationale behind the invention:

> The intolerable labor and fatiguing monotony of continued repetition of similar arithmetical calculations, first excited the desire, and afterwards suggested the idea, of a machine, which, by the aid of gravity or any other removing power, should become a substitute for one of the lowest operations of the human intellect.[13]

Babbage justified the machine above all as a labor-saving device, one that would also serve to make arithmetical calculation both much faster and entirely free of human error. Further elucidating the possible benefits of substituting machinery for humans, Babbage drew on the example of French mathematician Gaspard de Prony, who, in the wake of the Revolution and at the instigation of its interim government, produced a series of logarithmic and trigonometric tables, with numerical values worked out to unprecedented degrees of precision (to twenty-five decimal places in the case of sine values). This painstaking work—which had occupied Prony and his team of more than eighty human computers for several years—Babbage declared, could have been delegated to a machine such as the one he envisioned.

This was an impressive claim, one designed to stimulate Davy's interest while also (crucially) eliciting the support of the Royal Society—Babbage's machine would require a large financial outlay. Yet by invoking Prony's illustrious tables, Babbage implicitly made a case for a return on the investment.[14] His engine would not only save the British Treasury the £5,000 it intended to offer the French government for a copy of Prony's tables; it would also reduce the number of human beings employed in making any future tables that might be required from eighty to just one or two. Babbage's mechanical revision of Prony's venture, although strikingly original, was characteristic of broader early nineteenth-century views about calculation. As Lorraine Daston has argued, calculation had until recently been a highly regarded faculty of the intellect, but in the years after 1800 was increasingly associated with drudgery and unskilled labor.[15] Whereas Prony's tables were feted in revolutionary France as monuments to mathematical and political progress, Babbage saw their main contribution in industrial terms, as the quotation above suggests. He went on to itemize the thoroughgoing division of labor inside Prony's workshop. In charge were a few master mathematicians (including **(p.208)** Prony himself) who could manipulate algebraic formulae; below them were a team of *calculateurs*, who converted the algebra into numerical values; and at bottom were those with no knowledge of algebra, the ranks of so-called *ouvriers*, who were required to crunch the numbers by means of addition and subtraction only.

Thus, in the early 1820s, Babbage could boast that his machine had the potential to replace a considerable labor force almost entirely. The task of arithmetic calculation could be delegated to cogs and cams, leaving to human effort only the computing of initial values to be fed into the machine. (Babbage decided early on that the difference engine should be capable of printing its results.) His prospective engine drew luster from a contemporary discourse that linked mechanization to industrial progress—a theme picked up in 1823 by the earliest journalistic description of the machine, which compared its probable effects on science with "those rapid improvements in the arts which have followed the introduction of the steam engine."[16] Embedded in this gloss was an emerging analogy between scientific progress and progress in the (mechanical) arts—one that historians of science have detected across a range of phenomena from this period.[17] Specific to Babbage, however, and typically quirky, was the notion that Britain's dynamic factory system should provide a model for efficient scientific practice; and indeed that manufacturing processes could simulate operations that took place within the mathematician's mind.[18] Babbage self-consciously endowed his prospective machines with attributes of cognition, such as memory, recall, and foresight.[19] At their most ambitious, his machines represented hope for a grand three-way synthesis: of the factory system *as* human intelligence *as* calculating machine.

However, this imaginary equation—and with it, the prospect of artificial intelligence—crumbled under the pressure of practical exigencies. As Babbage quickly discovered, he had underestimated the work involved in building the machine: a huge undertaking that would oblige him to sustain a team of engineers and craftsmen throughout the 1820s and '30s. By the time he began work on the analytical engine in 1834, Babbage decided that he needed a dedicated space, and so adapted the land surrounding his residence on Dorset Street.[20] He transformed his home into a mini-factory, complete with workshops and offices—thus intensifying, albeit with the promise of ultimately overcoming, the human industry required for Prony's tables (although, of course, without Prony's numerical results). Yet the productivity of Babbage's domestic manufactory was undermined from the outset. His director of engineering, Joseph Clement, refused to relocate to the new premises, citing disputes over pay and working conditions, bringing work on the **(p.209)** machines to a fifteen-month standstill.[21] This bout of small-scale industrial action suggests that the conditions within the workshop were far from ideal; Babbage subsequently confessed that greater progress might have been made had his relations with Clement been better.[22]

There was a more fundamental glitch in Babbage's project that explains why his efforts to displace human intelligence with machines were subject to constant frustration. As Simon Schaffer has argued, Babbage sought always to minimize the human assistance required in the process of calculation, ruling out more flexible interactions between humans and machines.[23] By insisting that the human role should be reduced to data input (a task that would nevertheless have required mathematical training), Babbage attempted what we might call a grandiose concealment of labor—one that could supply the illusion of machine intelligence.[24] Schaffer identified Babbage as the precocious instigator of what would later become a pronounced tendency in computer culture—returning, for example, in Turing's experiments in the mid-twentieth century—that bestows metaphors of cognition on machines, all the while occluding the kinds of human intelligence required to make (and make use of) them. Schaffer rendered newly visible these obscured human-machine interactions, suggesting that the vogue for intricate automata in early nineteenth-century London can be particularly illuminating: in domestic and public displays of automata, the concealment of human skill, and the wonderment it elicited, was once again at issue, encouraging the same transposition of intelligence from craftsman to machine.[25]

And yet, in the exhibition of automata—and of Babbage's calculating machines—a vector also pointed in the opposite direction, linking humans to mechanisms by means of the intelligence involved in attending to them. Significantly, Babbage described this attentive intelligence in aural terms, as the effort involved in the act of listening to the difference engine. Consider, for example, Babbage's explanation to the lay reader of how the difference engine could reconfigure the "mental division of labor." His attempt at simplification by way of analogy—an elaborate thought experiment that shows how a particular mechanism might calculate the series of square numbers—devolved into relentless and baffling tintinnabulations:

Let the reader imagine three clocks, placed on a table side by side, each having only one hand, and each having a thousand divisions instead of twelve hours marked on the face; and every time a string is pulled, let them strike on a bell the numbers of the divisions to which their hands point. Let him further suppose that two of the clocks, for the sake of distinction called B and C, have some mechanism by which the clock C advances **(p.210)** the hand of the clock B one division, for each stroke it makes on its own bell; and let the clock B by a similar contrivance advance the hand of clock A one division, for each stroke it makes on its own bell. With such an arrangement, having set the hand of clock A to the division I., that of B to III., and that of C to II., let the reader imagine the repeating parts of the clocks to be set in motion continually in the following order: viz. pull the string of clock A; pull the string of clock B; pull the string of clock C. If now only those divisions struck or pointed at by the clock C [*sic*; Babbage meant clock A] be attended to and written down, it will be found that they produce the series of the squares of the natural numbers.[26]

Here the difference engine is presented as the mechanization of the method of differences. Clock C adjusted the hand of clock B, which in turn moved the hand of clock A, while clock C itself never changed from its initial value of two: it represented constant "difference" of a second order (because two clocks away from clock A, which showed the result). Babbage proposed that his difference engine should be able to compute twelve such orders of difference, which would correspond to numerical series much more complex than the square numbers.[27]

It is worth lingering over Babbage's imaginary machine. In addressing the lay reader, he conjured up a mechanical fantasy that described the difference engine as a parlor trick. We are offered strange clocks with miniscule divisions whose hands do not tell the time, but instead point to number series. The presentation of these series is doubled by the ringing of bells—as though to prove the results were independent of (abstractable from) the mechanism. Yet the illusion that the mechanism could *tell* the series of square numbers, like a grandfather clock tells the hours of the day, relied on a twofold concealment of labor: that of knowing what to listen for in the first place—the numerate training requisite for setting the initial values—as well as that of the attentive listening involved in counting the pealing of the bells. Their imagined sounds enhanced the illusion that the machine itself could perform the calculation, while distracting from the human skills and attentions that would be expended.

This kind of expert listening became reality when a partial "difference engine no. 1" was displayed at London's 1862 International Exhibition. For the occasion, three bells were added to the machine.[28] However, unlike their imaginary counterpart, these real bells did not toll out all numerical values; they were rung whenever a particular number series—the computed results, along with the first and second orders of difference, respectively—plunged from positive to negative values. The bells thus signaled crucial turning **(p.211)** points (zero values) in the computational process—important moments interpretable only by algebraically informed listeners. Not long after the exhibition, Babbage received a guest, evidently less mathematically adept than himself, who wanted to experiment with the machine:

> Several weeks after the machine had been placed in my drawing room, a friend came by appointment to test its power of calculating Tables. After the Engine had computed several Tables, I remarked that it was evidently finding the root of a quadratic equation; I therefore set the bells to watch it. After some time the proper bell sounded twice, indicating and giving the two positive roots to be 28 and 30. The Table thus calculated … really involved a quadratic equation, although its maker had not previously observed it.[29]

We are by now familiar with the notion that the difference engine carried out the active, intelligent work—it "computes," "finds," "watches," "gives" results. By contrast, Babbage merely registered (remarked on) what the bells were telling him, while his stupefied friend learned from the machine—Babbage acting as a passive conduit—that the equation he had devised must have been a quadratic one.[30] The ruse of machine intelligence was enabled by sounds, which transposed human skills and operations from a visible to an aural domain.

Street Music Machines

When the difference engine returned to Babbage's drawing room in 1863, it entered the midst of a community warzone: his Dorset Street home had become the site for a sustained attack on (and by) street music. By the early 1860s, the battle lines were drawn. On one side, there was Babbage himself and a few like-minded proprietors of London's professional middle classes.[31] Babbage received powerful, if intermittent, support from various establishment institutions: the Metropolitan Police Service, whose officers could arrest an offending street musician; the local magistrate, who might—or, as was often the case, might not—fine said musician up to forty shillings; and, at a greater remove, nonresident members of Parliament, such as Lord Westmeath and Michael Bass, both of whom (with Babbage's campaign in mind) presented bills to Parliament against street music in the metropolis.[32] On the opposite side of the ramparts were Babbage's less music-phobic neighbors, who not only encouraged street musicians but even sponsored them to play outside his home, expressly to irritate him. The "rough music treatment" **(p.212)** took place not only during his working day, but also while he slept: one night in December 1863, Babbage was awoken at 1:00 a.m. by a brass band firing up outside his bedroom window. A few weeks later he discovered that these musicians, urged on by his neighbors, had held a midnight rally to coordinate the exact moment of their attack.[33]

More precarious in relation to this middle-class battle of wills were the street musicians themselves: the itinerant brass-band players and organ grinders who toured the metropolis from early morning to late evening, returning at night to accommodations in the poor eastern districts of the city around Holborn Street and Farringdon Road.[34] A significant number of these musicians were not native to Britain, but were migrant workers indentured to compatriot entrepreneurs. Such was the unsteady constituency of Italian organ grinders against whom Babbage railed. Many of them, at least during the early 1860s, were wandering journeymen from the mountainous villages of the Val-di-Taro near Parma.[35] They were poor, often young men and sometimes children who arrived in London unable to speak English and usually without a musical instrument. Instruments could be rented on a daily basis—much like the white mice, monkeys and dancing dogs used by animal exhibitors—from local overlords of the street entertainment trade: available for hire were string-based hurdy-gurdies and the (more common) pipe-based, wind-up barrel organs. The latter ranged in size from the relatively small portable version that could be attached to the body by a shoulder strap, to the huge barrel piano varieties, which paraded aboard large wheelbarrow-like handcarts.[36] Babbage awarded these mobile music machines first place in his checklist of "instruments of torture permitted by the Government to be in daily and nightly use in the streets of London."[37] He estimated (perhaps conservatively) that there were a thousand organ grinders in circulation around the city at any given time.

This migrant industry represented a collective sonic force—one that, according to Babbage, necessitated an opposition cognizant of the economic sources of its cumulative power.[38] In "Street Nuisances," he broke the problem down into its three most significant variables: encouragers, performers, and instruments. Each needed to be tackled on its own terms. Most problematical were the encouragers, the public majority, who were likely to be offended by his tract. He picked off the most vulnerable factions first, gradually working his way up to his real target: frequenters of public houses, servants, children, and prostitutes ("ladies of elastic virtue and cosmopolitan tendencies"; thus far a roll call of the political underclass in mid-Victorian Britain), "visitors from the country," and ultimately "titled ladies; but these are almost invariably of recent elevation, and deficient in that taste which **(p.213)**

Table 8.1. Babbage's register of street nuisances showing performing monkeys alongside brass bands and organ grinders during one week in July 1863.

	Brass bands	Organs	Monkeys
July 3	3	—	—
July 4 (stone hit me)	—	2	—
July 5	—	1	1
July 6	—	1	—
July 7	—	1	—
July 9	—	1	—
July 10	—	1	—
(Tuesday—great mob)			

Source: **Adapted from Babbage's letter to Sir Michael Bass, published in *Street Music in the Metropolis* (London: John Murray, 1864), 20.**

their sex usually possess."[39] As this rebarbative flourish makes clear, his opposition to street noise was allied with hatred of women and of the working classes. Babbage's sly insinuation, clearly directed at his nouveau-riche neighbors around Manchester Square, was that street music was feminine, low-bred, and immoral.[40] Meanwhile, he recommended legal and political measures that could be taken against street performers and their borrowed instruments: that the police seize barrel organs (only to be returned on payment of a fine); that the government force magistrates to take a hard line on vagabond musicians; and if less stringent measures should prove futile, that street musicians in London be banned outright. Thus he rounded off his implacable manifesto, with the prospect of expelling a foreign menace: the xenophobic presentiment of a noiseless urban order.

Much like his calculating engines, Babbage thought of London as a perfectible machine, which could be constantly improved by elimination of the human element.[41] With a view to the latter's eventual demise, he began to take detailed observations of the noises circulating within the city, keeping a day-by-day log of the street nuisances as they passed his home. Table 8.1 shows the first seven entries in Babbage's register of disturbances on Dorset Street. He continued his record of brass bands, organ grinders, and monkey exhibitors for another 90 days, during which period he counted 165 separate infractions.[42] Babbage subsequently described the protocol he adopted in the case of incoming intruders:

> **(p.214)** Whenever … an itinerant musician disturbed me, I immediately sent out, or went out myself, to warn him away. At first this was not successful; but after summoning and convicting a few, they found out that their precious time was wasted, and most of them deserted the immediate neighborhood. This would have succeeded had the offenders been few in number; but their name is legion: upwards of a thousand being constantly in London, besides those on their circuit in the provinces. It was not, however, the interest of those who deserted my station to inform their countrymen of its barrenness; consequently, the freshly-imported had each to gain his own experience at the expense of his own and of my time. Perhaps I might have succeeded at last in banishing the Italian nuisance from the neighborhood of my residence; but various other native professors of the art of tormenting with discords increased as the license of these Italian itinerants was encouraged.[43]

Extraordinary here—and exceptional in the broader attack on street music at the time—was Babbage's proactive stance. It is as though he alone could keep itinerant musicians away from Dorset Street and the residential district surrounding Manchester Square. These musicians were doubly foreign—intruders both on the nation and, more offensively, on his dignified, well-to-do locale. Babbage pursued a solo campaign against a much larger system of musical migration (an effort that was doomed to failure, as the above quotation suggests) and, more generally, against the lower orders of society as a whole: "I have been compelled individually to resist this tyranny of the lowest mob, because the Government itself is notoriously afraid to face it."[44] We might well wonder: how exactly did the venerable philosopher square up against this anonymous multitude?

A more detailed example of Babbage's tactics can serve to show what happened when he personally went on the offensive. In one carefully described scenario, Babbage depicted himself suffering the onslaught of invading musicians—this time accompanied by a singing chorus of "shoeless children" and their "ragged parents"—sent by his neighbors to perform outside his window. He eventually lost his temper with this mirthful musical assault, exited his front door, and went in search of a policeman:

> In the meantime the crowd of young children, urged on by their parents, and backed at a judicious distance by a set of vagabonds, forms quite a noisy mob, following me as I pass along, and shouting out rather uncomplimentary epithets. When I turn round and survey my illustrious tail, it stops; if I move towards it, it recedes: the elder branches are then quiet— **(p.215)** sometimes they even retire, wishing perhaps to avoid my future recognition. The instant I turn, the shouting and the abuse are resumed, and the mob again follow at a respectful distance.[45]

Babbage vividly recounted his experience of turning to face the music: the threatening crowd encroached from behind, but grew quiet as soon he turned around—the mob disaggregated before his eyes, individual faces became unreadable. The problematic nature of identifying the mob resided in a split between an elusive visual reality and a seemingly irresistible aural channel. Sensation and ideology were conflated: the semantic freight of noise transferred from the social problem of street music onto the shouts and abuses of a mob. Babbage's implicit political aim was to bring this mob to heel. And this was what his opposition to street music implied: bolstering hegemony through a contest over sensory domains—what Jacques Rancière calls the always-conflicted "distribution of the sensible."[46]

I want to suggest that these sensory fluxions—patterns of perception that describe the contested field of politics—can be mapped locally, the walls of Babbage's Dorset Street home serving as a partition. Indoors, the elderly scientist labored on sketches for his engines, and the physical effort involved in this task defined his tangible hostility to street music:

> I claim no merit for this resistance; although I am quite aware that I am fighting the battle of every one of my countrymen who gains his subsistence by his intellectual labor. The simple reason for the course I have taken is, that however disagreeable it has been, it would have been still more painful to have given up a great and cherished object, already fully within my reach.[47]

When Babbage wrote these words, he had been designing calculating engines for over forty years. It is remarkable that he still entertained the prospect of completing his machine, long after the workshops around his home had shut down. Yet by 1864, his drive for "intellectual labor" on his engines had been substantially diverted into his campaign against street music. By expelling the intruders from around his home, he sought to calm the acoustic environment, thereby reestablishing conditions for steady concentration—which had now become an end in itself.

In attending to, and fighting against, the mechanical strains outside his windows, Babbage listened to the industrial city as though it were itself a machine, an autonomous social system that had taken on unstoppable, destructive force. The hoi polloi was polluting the atmosphere around his **(p.216)** home, which ought to have been the city's scientific nervous center (or so he thought). Within these musically contaminated environs, the notion that "one-fourth part" of his working power had been "destroyed" takes on renewed significance. Reading on, we learn that this residential soundscape was entwined with a projected industrial-intellectual economy: "Twenty-five per cent is rather too large an additional income-tax upon the brain of the intellectual workers of this country, to be levied by permission of the Government, and squandered upon its most worthless classes."[48] Here again, Babbage's factory-like mind revealed its aggressively economizing contours: its obsessions with the productive limits of thought. And it is at these limits that noise emerges as an object of political concern, making perceptible the link between brainwork and street music:

> When the work to be done is proportioned to the powers of the mind engaged upon it, the painful effect of interruption is felt as deeply by the least intellectual as by the most highly gifted. The condition which determines the maximum of interruption is,—that the mind disturbed, however moderate its powers, shall be working up to its full stretch.[49]

Intruding via the auditory pathway, street music pushed Babbage's working mind into overdrive. Its sonic pressure *was* the social friction that resisted the progress of his machine—and, by extension, the development of the economy, the city and the nation as a whole.

An Economy of Listening

In 1864, the year Babbage's "Street Nuisances" was published, Michael Bass's Bill for the Better Regulation of Street Music in the Metropolis was approved by Parliament. The latter meant that a street musician could be removed from the vicinity of any given home if there happened to be indoors someone "engaged in some serious occupation which required to be carried on without interruption."[50] Before Bass's amendment, only the presence of an invalid in the home permitted the property owner to have musicians removed by police officers; now reasonable cause also protected professionals working from home. With Babbage's experience before us, we might choose to pay special attention to Bass's carefully placed modifiers: his bill referred to "serious" occupations, which should be allowed to continue "without interruption"—qualifications that hint at pivotal nodes in the broader parliamentary debate. First among these were the competing claims of intellectual laborers versus workers in the street music trade; second, the basic (but nonetheless **(p.217)** contested) assumption that silence was required for intellectual labor to be pursued. These contested points defined the terms of discussion and the polarized background that Babbage's extreme views had been instrumental in instigating. London's economy was apparently imperiled, the metropolitan environment being identified as a zone of contest, where political action was figured in terms of the struggle over the city's sensible domains.

We might, in conclusion, try to sketch anew these parliamentary debates over street music with our ears trained on these economic and sensory aspects. Babbage's eccentric positions on these themes can illuminate, precisely because of their offbeat emphases, the larger discussion over street nuisances. Yet this indirect synergy between individual action and official politics can best be illustrated not by the successful implementation of Bass's act in 1864, but instead through Lord Westmeath's failed attempt to introduce his Barrel Organ Suppression Bill five years earlier. The parliamentary transcripts pertaining to this document evoke an insurgent, yet for now ill-defined anti-street-music sentiment. Westmeath's opening deposition played on (the by now familiar) xenophobic fears, the argument being framed in terms of exploitative/exploited migrant worker-musicians:

> The persons who annoyed the inhabitants of London were, as their Lordships were aware, chiefly foreigners, and were brought over here by persons who made a profit of their earnings, allowing them only a bare subsistence. He admitted that hospitality was due to foreigners, but he denied that the peace and tranquility of the metropolis were to be sacrificed to their convenience and profit. … Several persons had objected to his Bill on the ground that it would deny the public the gratification of listening to the German bands. That was a mistake. A man could not keep on blowing a wind instrument for ever; but a barrel organ never tired; it was a nuisance which never ceased, and was an object of universal detestation; and it was the object of his Bill to suppress it.[51]

Westmeath's parataxis revealed a jumble of complaints: first, barrel organs were more odious than wind instruments; second, they were mechanical and unremitting; third, everyone hated them. Subsequent speakers would challenge each of these points. Yet taken together, Westmeath's objections added up to a particular ideology: in comparing German bands with (Italian) organ grinders, he sought to identify the industrial-scale nuisance with its mechanical means of production. In other words, street music was denounced for its machine power—a force elsewhere celebrated as the cornerstone of the British economy. Westmeath claimed that the sound of barrel **(p.218)** organs "never ceased": much like capital flows theorized by Marx at the time, these instruments were allied to forces of circulation and production that had taken on a life of their own.[52] It was this systematic dimension of street music that also concerned Babbage; although, as I have argued, his complaint was more intricate than Westmeath's: he understood street music as a negative force that was in direct and sensuous conflict with the intellectual economy.

Westmeath's parliamentary opponents seized upon the idea of the economic vitality of street music.[53] Lord Lyndhurst, for example, charged that his learned friend had been blinkered to the wider economic and moral benefits of street music. These benefits were proved, Lyndhurst claimed, by the fact that the players were so often well-paid: "and if they were it could only be because their performances were agreeable to the humble proprietors of homes in that district, and [Lyndhurst] had as little doubt that it exercised a softening influence on their manners."[54] Invoking music's allegedly civilizing effects, he made the case for the propagation of mechanical music as a positive force. What is more, Lyndhurst saw no reason why such music should disturb those engaged in intellectual work—directly challenging Westmeath's (and Babbage's) implicit position that noise made concentration impossible. When pursuing his own mathematical studies in his London chambers, Lyndhurst explained, he trained himself to ignore a neighbor playing the violin, and had thus come to enjoy the more general benefits of greater resilience against widespread musical interruptions in the city. Such interruptions were, after all, an inevitable part of everyday life in a healthy industrial economy: Lyndhurst took pride (and masochistic pleasure?) in his ability to withstand disturbances; he encouraged his fellow lords and countrymen to demonstrate similar capacities for industry-resistant mental vigor.[55]

In the parliamentary debate, Lyndhurst was succeeded by Earl Granville, who seconded "every word that has fallen from the noble and learned Lord." However, Granville wanted to add another, more class-sensitive argument about the virtues of healthy, cheap street music:

> Only a very small proportion of the community were gifted with such exquisite ears that they could endure none but the most refined and costly music; and he could not see why, for the sake, perhaps, of some rich and highly-sensitive connoisseur, a whole neighborhood of poor people should be debarred of the innocent pleasure of listening to a barrel organ. The allusion to foreigners in the preamble of the Bill seemed to pander to an unworthy prejudice; and for his own part he infinitely preferred the **(p.219)** performances of a German band to the favored musicians alone exempted from the operation of the measure —namely, the sham base [*sic*] and falsetto singers, who trusted to the strength of their own lungs for their success, instead of having recourse to a much milder and more harmless instrument.[56]

As we have seen several times already—and is restated clearly here—the street music trade either caused offense or gave pleasure according to the business model being invoked—and the wider influence that that business could be presumed to have on the urban economy. For while Granville drew conclusions opposed to Westmeath's, they nonetheless concurred in their methods of assessing street music according to the sonic means of production: the "refined and costly music" represented by operatic voices were evaluated by the "strength of [the singer's] lungs," while the "innocent pleasure" of the patronized poor was increased by the "much milder and more harmless" entertainment represented by the barrel organ. In other words, street music was neither good nor bad in itself, but it stood for sheer sonic power. The act of hearing street music was split by a prevailing ideology, which encouraged politically minded Londoners both to listen *to* street music and also *through* it, for the human and/or machine labor involved in producing sonic energy. In mid-nineteenth-century London listening to street music thus came to mean, at least in part, listening to the circulation of sound within the metropolitan economy.

This view, encapsulated by the 1859 parliamentary debate, stands in naked contrast to Babbage's, which understood street music as a forcible drag on the economy. But the oppositional context represented by Lyndhurst and Granville (and other lords besides) helps define Babbage's campaign against street music as a political act: as the struggle of a particular, peculiar activist in the name of a utilitarian, tightly disciplined metropolitan order. Babbage promulgated an alternative, more ruthlessly industrial ideal for the economy in which the division of labor—that of workers, both manual and intellectual—might continue unimpeded by street music, thus reaching toward its productive maximum. What sustained this political configuration of musicians and machines, were the curious objects brought into fleeting aural contact at Dorset Street: Babbage's prospective calculating engines inside and the mechanized organ grinders without.[57] As engine and barrel organ were brought into proximity, Babbage morphed into a distinctive political actor: a prototype of an industrial human being tethered to the economy by the ear.

We have encountered Babbage's android listener once before in this essay: it is the deskilled worker imagined through his calculating machines, **(p.220)** which would have required of their operators *merely* to listen to numbers communicated by bells. These industrial, industrious sounds emerging from Babbage's home form a surprising counterpoint to the noisy streets beyond, calling attention to the untold ways in which Victorian capitalism interacted with listeners, and with modes of listening, in (and to) the city.[58] And it is, ultimately, against these broader vistas of urban, industrialized perception that Babbage's campaign against street music most powerfully signifies: against a polarized urban musical culture in which street music was defined by its distant relation to what was going on inside, in the rarified atmosphere of opera or concert or chamber music.[59] There is an unmistakable symmetry between concert audiences falling silent during the nineteenth century and Babbage's anguished efforts to preserve the equilibrium of his acoustic environment. Music indoors provided the unconscious blueprint for music outdoors, suggesting to Babbage, as to the intellectual laborers who stood behind Bass's bill, the utopia of an ambient texture in which patterns of attention were everywhere put to intelligent, productive use.

Notes

(1.) Cargill Gilston Knott, ed*., Napier: Tercentenary Memorial Volume* (London: Longmans, Green & Co., 1915), 1–32.

(2.) Johns, *Piracy: The Intellectual Property Wars from Gutenberg to Gates* (Chicago: University of Chicago Press, 2009), 327–56.

(3.) Moulton, "The Invention of Logarithms," 24.

(4.) Martin Campbell-Kelly cites this passage in his introduction to *Charles Babbage: Passages from the Life of a Philosopher* (London: Pickering, 1994), 34

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(8.) Editorial, *Morning Chronicle* (London), August 25, 1856. Five years earlier, Babbage had fallen into a dispute with the same newspaper: it was his policy to fight back against satire. In 1851, he leveled an accusation of calumny against the newspaper, over claims he had completely abandoned the difference engine (in favor of the analytical engine). The *Morning Chronicle* hit back that Babbage's claim was "a most extraordinary instance of the hallucinations into which men of genius may be hurried by irritability"; see "Mr. Babbage," *Morning Chronicle* (London), July 4, 1851.

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(10.) John M. Picker, *Victorian Soundscapes* (Oxford: Oxford University Press, 2003), 41–45.

(11.) Babbage, *Passages from the Life of a Philosopher*, 345.

(12.) Charles Babbage, "A Note Respecting the Application of Machinery to the Calculation of Astronomical Tables" *Memoirs of the Astronomical Society* 1 (1822): 309Babbage, *The Works of Charles Babbage*, 2:3–4

(13.) "A Letter to Sir Humphry Davy, Bart, President of the Royal Society, On the Application of Machinery to the Purpose of Calculating and Printing Mathematical Tables" (1822), reprinted in Babbage, *The Works of Charles Babbage*, 2:6.

(14.) ibid., 2:14

(15.) Lorraine Daston, "Enlightenment Calculations," *Critical Inquiry* 21, no. 1 (1994): 186.

 (16.) See F. Baily, "On Mr Babbage's New Machine for Calculating and Printing Mathematical and Astronomical Tables," *Astronomische Nachrichten* 46 (1823): col. 409–22, reprinted in Babbage, *The Works of Charles Babbage*, 2:44–56.

(17.) Daston, "Enlightenment Calculations," 200; see also Bowler and Morus, *Making Science Modern*, 397.

(18.) William J. Ashworth, "Memory, Efficiency and Symbolic Analysis: Charles Babbage, John Herschel, and the Industrial Mind," *Isis* 87 (1996): 629–53.

(19.) Simon Schaffer, "Babbage's Dancer and the Impresarios of Mechanism," in *Cultural Babbage: Technology, Time and Invention* (London: Faber & Faber, 1996), 53–80.

(20.) Anthony Hyman, *Charles Babbage: Pioneer of the Computer* (Princeton, NJ: Princeton University Press, 1985), 128.

(21.) Babbage, *Passages from the Life of a Philosopher*, 82Ivor Guest, "Babbage's Ballet," *Ballet* 5, no. 4 (1948): 51–56.

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(24.) Schaffer, "Babbage's Dancer," 70.

(25.) On automata and pseudo-automata in early nineteenth-century London, see also the essays by Myles Jackson and Melissa Dickson in this volume.

(26.) Charles Babbage, *On the Economy of Machines and Manufactures* (London: Charles Knight, 1832), 160–61.

(27.) *dxx*Andrew Warwick, *Masters of Theory: Cambridge and the Rise of Mathematical Physics* (Chicago: University of Chicago Press, 2003), 67–68.

(28.) Babbage, *Passages from the Life of a Philosopher*, 66*On the Economy of Machines and Manufactures*Babbage, *Passages from the Life of a Philosopher*, 119Babbage, *The Works of Charles Babbage*, 2:232.

(29.) Babbage, *Passages from the Life of a Philosopher*, 65–66.

(30.) Schaffer, "Babbage's Dancer."Joe Kember, John Plunkett, and Jill A. Sullivan, eds., *Popular Exhibitions, Science and Showmanship, 1840–1910* (London: Pickering and Chatto, 2010).

(31.) Picker, *Victorian Soundscapes*, 41–81. Picker discusses the way in which street music served as a foil for the construction of middle-class professional, male identity in mid-Victorian London for a range of writers working from home. By making the streets quiet and thus "domesticating" them, Picker argues, these writers sought to establish their dominance over— and to articulate their sonically marked difference from—both the lower orders of society and foreign street musicians. My argument in this essay is slightly different; by focusing on Babbage —whose ideas were eccentric, but for that reason can illuminate broader common ground—I want to underscore the economic basis of contemporary debate. In other words, despite the huge difference in status between street musicians and professionals (such as scientists), such class distinctions threatened to be undermined by an emerging social hermeneutics, whereby both could be understood to be productive workers within the same economy—different kinds of workers (but workers nonetheless) who were thrown into sensible contact and competition through their copresence in space.

(32.) Rachel Cowgill, "On the Beat: the Victorian Policeman as Musician," in *Victorian Soundscapes Revisited*, ed. Martin Hewitt and Rachel Cowgill (Leeds, UK: University Print Services, 2007), 191–214.

(33.) Babbage, *Passages from the Life of a Philosopher*, 352–53.

(34.) See John E. Zucchi, *Little Slaves of the Harp: Italian Child Street Musicians in Nineteenth-Century Paris, London and New York* (London: McGill-Queen's University Press, 1992), 1–41, 76– 110. See also: Henry Mayhew's account, "Street Musicians," in *London Labour and the London Poor: The Condition and Earnings of Those That Will Work, Cannot Work, and Will Not Work* (London: Charles Griffin & Co., 1851), 3:168–99.

(35.) See, e.g., Mayhew's account, "Organ Man, With Flute Harmonicon"; *London Labour and the London Poor*, 3:184.

(36.) Arthur W. J. G. Ord-Hume, "Barrel Piano," *Grove Music Online*: *Oxford Music Online* (Oxford University Press), accessed March 8, 2014, http://www.oxfordmusiconline.com/subscriber/ article/grove/music/02112.

(37.) Babbage, *Passages from the Life of a Philosopher*, 338.

(38.) Derek B. Scott, *The Sounds of the Metropolis: The 19th-Century Popular Music Revolution in London, New York, Paris, and Vienna* (Oxford: Oxford University Press, 2008), 15–37.

(39.) Babbage, *Passages from the Life of a Philosopher*, 338.

(40.) Heather Shore, "Mean Streets: Criminality, Immorality and the Street in Early Nineteenth-Century London," in *The Streets of London: From the Great Fire to the Great Stink*, eds. Tim Hitchcock and Heather Shore (London: Rivers Oram, 2003), 151–64.

(41.) "Music in the Air: Noise, Performers and the Contest over the Streets in Mid-Victorian Britain," in Hitchcock and Shore, *The Streets of London*, 183–207.

(42.) Michael Bass's *Street Music in the Metropolis* (London: John Murray, Albemare Street, 1864), 20–22.

(43.) Babbage, *Passages from the Life of a Philosopher*, 347.

(44.) Ibid., 345.

(45.) Ibid., 349.

(46.) Jacques Rancière, *The Politics of Aesthetics: The Distribution of the Sensible* (London: Continuum, 2006), 7–14.

(47.) Babbage, *Passages from the Life of a Philosopher*, 345.

(48.) Ibid.

(49.) Ibid., 346.

(50.) "Leave," *Hansard* (House of Commons debate held on May 3, 1864), vol. 174, 2116–19.*Forty Shillings*

(51.) "Second Reading: Negatived," *Hansard* (House of Lords debate held on April 29, 1858), vol. 149, 1925–30.*Hansard*

(52.) Nathan Rosenberg, *Exploring the Black Box: Technology, Economics, and History* (Cambridge: Cambridge University Press), 24–46.

(53.) James Winter, *London's Teeming Streets, 1830–1914* (London: Routledge, 1993), 77.

(54.) "Second Reading: Negatived," 1928.

(55.) On the Victorian manliness and mathematical studies, see Warwick, *Masters of Theory*, 176–226.

(56.) "Second Reading: Negatived," 1929.

(57.) Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (Oxford: Oxford University Press, 2005), 63–70.

(58.) *Suspensions of Perception: Attention, Spectacle, and Modern Culture* (Cambridge, MA: MIT Press, 2001).

(59.) References to concert music are rare in Babbage's writings, but in his autobiography he hints at a connection between mechanization and attentive listening in an account of a concert held at Hanover Square Rooms in the early 1840s—one of the orchestral and choral extravaganzas organized by the elite Society for Ancient Music: "Soon after I had taken my seat at the concert, I perceived Lady Essex at a short distance from me. Knowing well her exquisitely sensitive taste, I readily perceived by the expression of her countenance, as well as by the slight and almost involuntary movement of the hand, or even of a finger, those passages which gave her most delight. These quiet indications, unobserved by my friends, formed the electric wire by which I directed the expressions of my own countenance and the very modest applause I thought it prudent to develop" (Babbage, *Passages from the Life of a Philosopher*, 427–28).

Notes:

(1.) Cargill Gilston Knott, ed., *Napier: Tercentenary Memorial Volume* (London: Longmans, Green & Co., 1915), 1–32.

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(37.) Babbage, *Passages from the Life of a Philosopher*, 338.

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(57.) Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (Oxford: Oxford University Press, 2005), 63–70.

(58.) *Suspensions of Perception: Attention, Spectacle, and Modern Culture* (Cambridge, MA: MIT Press, 2001).

(59.) References to concert music are rare in Babbage's writings, but in his autobiography he hints at a connection between mechanization and attentive listening in an account of a concert held at Hanover Square Rooms in the early 1840s—one of the orchestral and choral extravaganzas organized by the elite Society for Ancient Music: "Soon after I had taken my seat at the concert, I perceived Lady Essex at a short distance from me. Knowing well her exquisitely sensitive taste, I readily perceived by the expression of her countenance, as well as by the slight and almost involuntary movement of the hand, or even of a finger, those passages which gave her most delight. These quiet indications, unobserved by my friends, formed the electric wire by which I directed the expressions of my own countenance and the very modest applause I thought it prudent to develop" (Babbage, *Passages from the Life of a Philosopher*, 427–28).

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