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ABSTRACT New technologies profoundly change our sonic surroundings, the world's *soundscape*. However, research dealing with the sound of technology is scarce within Science and Technology Studies (S&TS). This study argues that such a silence should be broken, since the sound of technology not only tunes our sonic environment, but has also been a highly controversial aspect of technology loaded with symbolic significance. Research into such a symbolism of sound enhances our understanding of the responses to technology-related changes in early 20th-century Western cities. The importance of sound will be made clear by discussing the historiography and anthropology of noise and silence, and by analyzing a crucial episode in the history of noise abatement in European and North American cities. By showing how the symbolism of sound influenced the noise abatement campaigns and the measures taken in response, the paper illustrates how the study of technological culture can be deepened by focusing on sound.

Keywords acoustics, cities, environment, silence, 'soundscape', traffic control

The Diabolical Symphony of the Mechanical Age:

Technology and Symbolism of Sound in European and North American Noise Abatement Campaigns, 1900–40

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> Beginning with the primordial sounds of nature, we have experienced an ever-increasing complexity of our sonic surroundings. As civilization develops, new noises rise up around us: from the creaking wheel, the clang of the blacksmith's hammer, and the distant chugging of steam trains to the 'sound imperialism' of airports, city streets, and factories.

This statement is quoted on the cover of *The Soundscape: Our Sonic Environment and the Tuning of the World*. In this fascinating book, the Canadian composer Raymond Murray Schafer documents how both the Industrial and the Electrical Revolution profoundly changed our sonic environment, the world's soundscape.[1] The hi-fi soundscape of pre-industrial life, in which sounds could be heard 'clearly without crowding or masking', gave way to a lo-fi one in which 'signals are overcrowded'. The ambient level of noise increased in terms of decibels, and was extended in terms of frequencies. Machines created ever-lasting, continuous noises: drones, the flat lines in sound. In short, the 'keynote' of our Western society modulated.[2]

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Since many of such sonic changes can be attributed to the introduction of new technologies, it is hard to understand why research dealing with the sound of technology is scarce within Science and Technology Studies (S&TS). Exceptions usually concentrate on the relation between machine noise and music, and on music-related technologies such as the radio, the sound-film and the phonograph.[3] Generally speaking, however, the S&TS community addresses itself to the way technology has been viewed, not to the way it has been heard. In describing the co-evolution of technology and society, the changing order of the world is shown in terms of its visible exterior, not in terms of its sounds, in spite of Ruth Schwarz Cowan's famous 'hum' of the refrigerator, and the whistle of the locomotive in Leo Marx's *The Machine in the Garden*.[4] The history of sound has been dealt with by cultural, medical, urban and environmental historians, musicologists and anthropologists. As far as the contribution from technology studies is concerned, one can speak of a deafening silence.

The main goal of this paper is to convince the S&TS audience that such a silence on sound within technology studies should be broken. The sound of technology not only marks our sonic environment, but has also been a highly controversial aspect of technology – an aspect invested with symbolic significance. As Leo Marx has shown in 19th-century American literature, the sounds of trains and factories were depicted as aggressive signals that invaded the serene and secure 'peace of an enclosed space', thus symbolizing the disturbance of the pastoral ideal.[5] Research into such symbolism of sound can similarly enhance our understanding of the responses to technology-related changes in early 20th-century city life: the sound of technology should thus be listened to and analyzed.

The case for sound will be clarified along two lines. First, the most interesting studies into the history and anthropology of noise and silence will be presented, especially those concerning the symbolism of sound and its relation to technology. This overview is meant to give an idea of how research into sound, or research by listening, can enable those studying technology to grasp new dimensions of technological culture.

In the second line of enquiry, these dimensions will be used to analyze an episode in the lively history of noise abatement in European and North American cities, with a special section on the Netherlands. Complaints about city noise have a long history. In the first half of the 20th century, such complaints increasingly focused on the 'nerve-racking' noises of factories, traffic, transport, gramophones and radio. In essays and pamphlets, lively descriptions of modern noise were given, together with a diagnosis of the causes, and suggested solutions to the noise problem. Moreover, all over Europe and the United States, anti-noise leagues were formed, organizing anti-noise conferences, anti-noise campaigns, anti-noise exhibitions and 'silence weeks'.

The ramifications of this episode illustrate how the new technologies (and the sounds that came along with them) were considered to cut through the existing societal order. Initially, the struggle for silence was mainly phrased in terms of the 'civilized' needs of the intellectual élite

against the 'indifferent', 'irrational' and 'barbarous' behaviour of the masses, whereas noise-abators showed little hostility towards technology itself. Even in the later phases of noise abatement, when city noise, measured in terms of loudness scales, increasingly came to be defined as a general health hazard negatively affecting the efficiency and productive capacity of all city dwellers, sound continued to be associated with social distinctions and noise with a lack of manners.

Consequently, public education by teaching a 'noise etiquette' came to be seen as the alpha and omega of controlling the city noise problem. Although practical measures such as alternative pavements and new transportation constructions were also proposed and executed, public education continued to be seen as the ultimate way of creating silence: it kept dominating the rhetorics of noise abatement. Changes in law and technology, such as traffic control and city planning that enabled the creation of new forms of integration and order – a new smooth rhythm, so to speak – in city life, remained a second-best option. If we are to understand the genesis of the problem definitions, the proposed solutions and the extent to which the proposals came to be accepted, we must invoke the cultural meaning of sound. Therefore the historiography and anthropology of noise and silence must be introduced first.

'Breaking the Sound Barrier': The Symbolism of Noise and Silence

Recently, the historian Peter Bailey has 'banged the drum for noise' in an article titled 'Breaking the Sound Barrier'. A general history of noise, Bailey claims, should map out changes in the production of noise in terms of its 'means, type and volume'. Furthermore, such a history should focus on the subjective and culturally determined perception and response to noise, as well as on the changing hierarchy of sensory perception. Showing important temporal, class, gender and age differences in relation to noise attitudes, and stressing the increasing dominance of visual over auditive perception, Bailey largely lives up to the task with which he charged historians of noise.[6] Most important are his remarks on the symbolic meaning of noise and silence in Western culture. This section will focus on the history and anthropology of this symbolism of sound and its relation to technology, by discussing Bailey's contributions, as well as those of Raymond Murray Schafer and many others.

Bailey distinguished three types of socially defined noise: noise as merriment (such as laughter); noise as embarrassment (such as the fart); and noise as terror. The last type of noise has been discussed most frequently in the literature. As Bailey and other authors have made clear, noise – varying from shouting to the machine-made noise of shooting and bombing – has always been an important ingredient of warfare. It is meant to steel one's own forces, as well as to terrify the enemy. Besides, noise can be a form of 'symbolic violence of the crowd', a kind of 'counter-terror', and has traditionally been employed to 'intimidate, shame and ridicule

enemies of the people and offenders against traditional values'. Rough music, 'katzenmusik' or 'kettlemusic', a cacophony of noises produced by shouting, laughing, chanting and the drumming of pots and pans could, for example, be used to embarrass those just married. In less innocent versions, kettlemusic was aimed at terrifying those accused of scandalous behaviour. Whatever the context, Bailey writes, rough music has been 'the sound of disorder'.[7]

This powerful and socially disrupting potential of noise is intriguing, and it is worth reflecting on its connection with technology. According to Raymond Murray Schafer, the association of noise and power has always been part of 'the human imagination'. Throughout history, societies have known certain types of noise, *Sacred Noise* in Schafer's vocabulary, which were 'not only absent from the lists of proscripted sounds which societies from time to time drew up', but were in fact 'quite deliberately invoked as a break from the tedium of tranquillity'. Creating such noise – in religious festivals celebrating the harvest, in rituals exorcizing evil spirits, in ringing churchbells, in playing the organ – is aimed at making the deity listen. Those in society in possession of Sacred Noise, Schafer stressed, not only made 'the biggest noise', but actually had 'the authority to make it without censure'. Where noise was granted 'immunity from human intervention', 'a seat of power' could be found.[8] The gods with their thunder and lightning, and the priests with their drums and bells, were traditional examples of this phenomenon.

Schafer extends this line of thought to technology. Sacred Noise, he claims, was eventually transmitted to machines. Its power descended from 'God, to the priest, to the industrialist, and more recently to the broadcaster and the aviator'. Only this transfer, Schafer believes, can really explain the astonishing fact that the toxicity of industrial noise was not recognized until the late phases of the Industrial Revolution. In England, the first protests against labour conditions such as working hours, machine accidents and child labour, were raised as early as the 1830s. Criticism of noise was scarce, however. Not before the end of the 19th century did physicians generally hold industrial din to be a cause of hearing impairment, and the prevention of industrial hearing loss 'only received serious consideration in most industrialized countries toward 1970'. This delay could partly be due to the inability to 'measure sounds quantitatively', since the decibel 'did not come into extended use until 1928'. Schafer's most important explanation, however, as mentioned above, is the transmission of power from church officials and other authorities to industrialists, who were now 'granted dispensation to make Noise'.[9]

Much counter-evidence can be advanced against Schafer's account of historical events. First, the prevention of industrial hearing loss started earlier than Schafer suggests. According to the medical historian Allard Dembe, industrial noise control, at least in the United States, began around 1900 with the reduction of the noise of production equipment, since engineers realized that 'noisy machinery' could be 'an indication of mechanical inefficiency'. In the 1950s, after a rapid growth of workers'

compensation claims, the use of hearing protection became familiar, although the adoption of legislation with respect to industrial noise standards was indeed delayed until 1970. Second, Schafer's explanation for the comparatively late establishment of industrial noise control seems incomplete. Dembe did not mention the 'might' of industrialists or the 'sanctity' of industrial noise, but instead claimed that a more general 'cultural association of loud industrial noise with admired societal traits' (such as strength, progress, prosperity and prowess) had hampered the recognition of noise-induced hearing loss as a disorder deserving compensation. Another hindrance, Dembe stressed, had been the need for evidence of injuries. Such proof could only be gathered through large-scale audiometric testing, which started in the 1930s. Noise control was further impeded by the fact that 'for most occupations, a partial loss of hearing [was] not critical to the performance of the job',[10] as well as by the costs of prevention and the economic crisis of the 1930s.[11]

On the other hand, the remarks of Dembe and others indicate that the association of noise-as-loud-sound with power-as-strength-and-significance is indeed an important aspect of the attractiveness of specific technologies. In his study of the meaning of village bells in the 19th-century countryside of France, Alain Corbin has carefully documented the perceived correlation between the loudness of bells and the significance of parishes and municipalities. Thus, bells served to 'give expression to hierarchies', and also to 'defend a territory', 'impart a rhythm to time', 'identify personages deemed worthy of honor', 'make announcements, exhort people to assemble, sound the alarm, and express general rejoicing'.[12] It was, Corbin stressed,

> ... as if the powerful ringing of the bell represented a victory over chaos and, for a community, a symbol of cohesion regained; it was an instrument whose sound enabled people to assemble, and it was the sign of a social order founded on the harmony of collective rhythms.[13]

Similarly, studies of African cultures show that the sounds of drums and words are often attributed with a force of their own, and with the strength of ancestors.[14] According to William H. McNeill, 'moving rhythmically while giving voice together', or 'muscular bonding' through community dance, song and drill *has* a force of its own: it 'arouses warm emotions of collective solidarity'.[15] In mass gatherings, McNeill makes clear, it can also give people a sense of irresistible strength. Such has been the case in times past, and can still be found in phenomena such as the rhythmic movements, yells and songs of sport fans.

In 20th-century Western culture, in many ways, loudness of technology continued to be associated with strength. Although it would be no problem to produce a relatively silent vacuum cleaner, manufacturers maintain that the public does not want such artefacts, since they raise suspicions that they have no suction power.[16] Likewise, in 1923, promotors of the electric

car sadly noted that 'the rattle and clatter of the gasoline vehicle impress [the man in the street] more than the quiet reserve and staying qualities of the electric'.[17] Men were held to love the din of the internal combustion engine for its expression of speed, risk and power. In a series of Motor Boys and Motor Girls novels, published between 1910 and 1917, the Boys preferred 'their cars noisy, like racing cars, and even disconnect[ed] mufflers', whereas the Girls liked a different sound. According to one Girl: 'The car went noiselessly – the perfection of its motion was akin to the very music of silence'.[18]

In line with this represention, the semiotician Antero Honkasalo has argued that noise can be an 'indexical sign' referring to danger and machismo. The noise of the stone hammer, for example, tells the diver that 'danger is present', and it 'is a tough man's' job to tolerate it. It may be for this reason that 'young boys like driving mopeds without exhaust pipes, heavy rock players set the amplifiers as loud as possible, or "muscle boat" owners use full speed and power even near summer cottages'.[19] The noise that young moped-drivers and the drivers of 'booming' cars create has likewise been characterized as the display of masculinity and strength.[20]

Observations and interpretations of this kind can best be structured with the help of Anthony Jackson's analysis in 'Sound and Ritual', an early review of the notion of sound in the anthropological literature of Claude Lévi-Strauss, Mary Douglas and others. According to Jackson, man-made noises, or unpatterned, disordered, arhythmical sounds in ritual, 'reflect uncontrolled situations or transitional states or threats to patterned social order', while 'a taking up of a rhythmical beat again reasserts human control over events'.[21] Although Jackson modestly characterizes his conclusions as 'speculation', his findings largely fit with the historical and anthropological work mentioned above. For these studies have shown that noise as 'unwanted sound', whether regular or unpatterned, has often been associated with a terrifying disruption of a specific social order, whereas rhythmic and/or loud, positively evaluated sounds have been associated with strength, power, significance, masculinity, progress, prosperity and, last but not least: *control.*

Extending this line of thought, noise as 'unwanted sound' has much in common with dirt as 'matter out of place' in Mary Douglas's work on 'purity and danger'. In primitive societies, the aversion to dirt and the striving for purity – in rules with respect to food, sex and the body – are ways of creating order out of chaos, and of keeping classifications within social systems clear. Moreover, the fight against dirt can be a symbol as well as a lightning-rod of deeper societal conflicts.[22] Others consider Douglas's remarks on primitive societies to be applicable to modern societies, too.[23] The striving for purity in the German Culture and Life Reform Movement (*Kultur- und Lebensreformbewegung*) around 1900 has, for instance, been related to a general fear of change, ambiguity and blending, typical for a period of rapid modernization.[24] Whether obsessions with noise have been more dominant in stages of societal transition cannot

be decided yet, but noise as 'unwanted sound' has certainly functioned as a symbol of disorder.

The Symbolism of Silence

Yet such a symbolism of sound is incomplete without knowledge of the symbolism of silence. The historian Peter Burke devotes one chapter of his book about *The Art of Conversation* to 'silence' in pre-modern Europe. Legal records, travellers' accounts and etiquette books informed him about the principles underlying the system of silence in that age. Many of his observations mirror those of Schafer about pre-industrial life. Silence, Burke makes clear, was associated with showing respect or deference for those higher in the societal hierarchy. Monks were supposed to be quiet in the presence of God, courtiers in the presence of the prince, women in the presence of men, children in the presence of adults, and servants in the presence of their masters.[25] In antiquity, Anne Carson claims, men were even supposed to control the sound of women in case women did not control their sound themselves: 'Silence is the *kosmos* [good order] of women', Sophocles said.[26] Moreover, again according to Burke, silence was a sign of prudence, whether resulting from fear, from 'the dissimulation of princes', or from 'the discretion of the wise'.[27]

Burke suggests that this system of silence underwent changes between 1500 and 1800. During this era, an increasing concern with self-controlled speech arose. This may have been related to the Reformation and its stress on ecclesiastical silence, as well as to the fear of spies at the courts of the absolute monarchy.[28] Burke speculates that 'the bridling of the tongue' can even have been connected to the rise of capitalism, since a 16th-century Englishman made a comparison between 'spending and saving words and money'. According to Burke, the rise of controlled speech was a general European movement, but has been more effective in the Protestant than in the Catholic regions, thus 'widening the gap' between a 'more silent' north and a more 'talkative' south.[29]

A connection not mentioned by Burke, but possibly relevant, is the rise of new forms of science, and the relation between modern science and sight. About the hierarchy of sensory perception, Bailey says that 'pre-modern societies were predominantly phonocentric, privileging sound over the other senses in a world of mostly oral-aural communication', whereas the 'advent of typographic print in the 15th century gave a dramatic new saliency to visual perception'.[30] Research into the history and anthropology of the senses has added some critical observations to this account.[31] Yet many authors support the notion that in Western society, knowledge is closely associated with sight. According to Jacques Attali, science has always 'tried to look upon the world', desiring to 'monitor' its meaning.[32] Such statements should be qualified by saying that profound changes in natural philosophy during the 16th and 17th centuries, and the new reliance on observation and experiment as the legitimate sources of knowledge, as well as the growing importance of print as a vehicle of communication,

gave rise to a situation in which our knowledge of the world increasingly came to be expressed in visual terms.[33] Thus the early modern rise of new forms of science may have contributed, indirect as this connection may be, to the increased élite engagement with keeping silence, as described by Burke.

Summary

In sum, the historiography and anthropology of sound make clear that noise and silence refer to deeply-rooted cultural hierarchies. The right to make noise, as well as the right to decide which sounds are allowed or forbidden, has long been the privilege of the powerful, whereas those lower in rank (women, children, servants) were supposed to keep silent, or were under suspicion of intentionally disturbing societal order by making noise. Positively evaluated loud and rhythmic sounds have had connotations of strength, significance and control, whereas noise as unwanted sound has often been associated with disorder. Between the 16th and 19th centuries, the élite became increasingly obsessed with controlling its own sound, at least speech. In addition, sight began to dominate sound in communication.

As we have seen and will see, such symbolism has also been transferred to modern technology, which makes sound an important entry for research into responses to technology-related changes.[34] In the next section, the relevance of such symbols will be shown by analyzing noise abatement campaigns in Europe and North America during the first half of the 20th century. In order to put that search for silence into a broader context, it is valuable once again to dwell upon Leo Marx's *The Machine in the Garden*. Marx described how, in 19th-century American literature, 'the long shriek' of the locomotive symbolized the disturbance of the pastoral ideal. The noise aroused 'a sense of dislocation, conflict and anxiety'. It referred to the tension between industrialization and the rural, green, orderly and quiet environment, or the ideal of withdrawal 'from civilization's growing power and complexity'. Although 'the rhetoric of the technological sublime', with energy, power and grandeur attributed to the machine, dominated the American magazines of 'the governmental, business and professional elites',[35] literary writers positioned the rattle of railroad-cars and the thunder of engines as the signs and symbols of dissonance. Yet harmony could be brought within reach again, it was felt, by dedicating technology to the taming of the wilderness of the remaining virgin land into a cultivated garden-landscape.

For such a solution, European and North-American city dwellers of the 20th century literally and symbolically had no 'room'. As we will see below, those who published on noise did not expect to find solace in rural life. In late 19th-century and early 20th-century Europe, the nuisance of noise was first and foremost conceptualized as the disturbance of social hierarchy. Its dissolution was not sought for by taming the new land, but by taming the people and by creating a new rhythm in city life.

The City Noise Problem: Civilization versus Barbarism

Complaints about noise seem to be a part of all recorded history.[36] In the second half of the 19th and at the start of the 20th century, many such complaints, at least the European and the public ones, came from intellectuals.[37] They generally considered noise to be a brute assault on their mental refinement. The lamentation of Arthur Schopenhauer, published in 1851, is the most famous of their charges – an ever recurring *Leitmotiv* in the noise literature. Schopenhauer regarded the cracking of whips as a hideous sound, distracting him from his philosophical work:

> [Whip-cracking makes] a peaceful life impossible; it puts an end to all quiet thought. ... No one with anything like an idea in his head can avoid a feeling of actual pain at this sudden, sharp crack, which paralyzes the brain, rends the thread of reflection, and murders thought.[38]

According to Schopenhauer, many people showed no sensivity to noise. However, such people were likewise insensible to 'arguments, ideas, poetry and art – in sum, to mental impressions of all kinds, due to the tough and rude texture of their brains'.[39]

Phrasing his complaints in a similar way, the mathematician Charles Babbage successfully campaigned against the 'nuisance' of London street music in 1864. 'The great encouragers of street music', Babbage wrote, 'belong chiefly to the lower classes of society', such as tavern-keepers, servants, visitors from the country and 'Ladies of doubtful virtue'.[40] The instruments of 'torture' which they seemed to love destroyed 'the time and the energies of all the intellectual classes of society'.[41] Although Babbage knew that the invalid and the musical man were also annoyed, his pamphlet mainly focused on 'the tyranny of the lowest mob' upon 'intellectual workers'.[42] The Austrian ethnologist Michael Haberlandt simply claimed that the more noise a culture could bear, the more 'barbarian' it was; in contrast, tranquillity was 'the womb of all higher intellectuality'.[43]

Neither Schopenhauer, Babbage nor Haberlandt mentioned the roar of machines or motorized traffic. Succeeding intellectuals, however, increasingly transferred the élitist convictions of their predecessors to such new sounds and, as Bailey has shown, spoke about the struggle for silence in terms of civilization versus barbarism. The psychologist James Sully, for instance, published an essay entitled *Civilisation and Noise* in 1878, in which he argued that:

> If a man wanted to illustrate the glorious gains of civilisation, he could hardly do better, perhaps, than contrast the rude and monotonous sounds which serve the savage as music and the rich and complex world of tones which invite the ear of a cultivated European to ever new and prolonged enjoyment. ... Yet flattering as this contrast may be to our cultivated vanity, it has another side which is by no means fitted to feed our self-complacency. If the savage is incapable of experiencing the varied and refined delight which is known to our more highly developed ear, he is on the other hand secure from the many torments to which our delicate organs are exposed.[44]

Such a torment was the 'piercing noise of a train, when brought to a standstill by a break', he explained. Another was the 'diabolical hooter' reminding railway workers of 'their hour of work'. The loudness and harshness of these and comparable sounds of traffic and factories were the 'proverbial plague' of the student. Concentration, the 'counteractive force' of civilized man, was not enough to neutralize the effects of the increased sensibility and the irritating impressions amid the dense, and often indifferent, population of the cities.[45]

In 1908, the German cultural philosopher and physician Theodor Lessing was even more outspoken in his essay *Der Lärm: Eine Kampfschrift gegen die Geräusche unseres Lebens*. Lessing declared that he was annoyed by both traditional noise, such as the din of churchbells and carpet-beating, and the more recent nuisance of rattling machines, shrilling gramophones, ringing telephones and roaring automobiles, buses, trams and trains. The latter type of noise, however, was 'incomparably worse' than the former and made present-day life 'nerve-racking'.[46] For Lessing, as for Sully, noise was profoundly anti-intellectual. Noise, Lessing asserted, raised and exaggerated deeply-rooted human instincts and emotions – the 'subjective' functions of man's soul – and narrowed and dimmed the intellectual and rational – 'objective' – functions of the soul. Noise was the most primitive and most widely applied means to deafen consciousness. In fact, noise was the '*vengeance*' of the labourer working with his hands against the brain-worker who laid down the law to the former. Silence, on the other hand, was the sign of wisdom and justice. 'Culture', Lessing stressed, 'embodied the genesis of keeping silent'.[47]

Dan McKenzie, an English surgeon and author of *The City of Din: A Tirade Against Noise* (1916) claimed roughly the same. If his crusade would be successful, he wrote, one of the consequences would be that 'the raucous tones of the raucous-minded would give place to the gently-voiced opinions of the mild and tolerant. So that this particular crusade is only one small part of a grand effort at the refinement of the human spirit . . .'.[48] 'In the long run', the English accounting expert Stanley Rowland stated in 1923, the difference between the noisy and the not-noisy was that 'between self-possession and self-assertion – or, more generally, self-diffusion'. One could encounter such self-diffusion at the theatre, where people kept up 'a running commentary on the action', in the 'abominable shrieks' of newsboys distributing newspapers, as well as in the 'brutal objurgativeness' of the motor-horn, the 'outrageous noisiness of the motor cycle', and the 'semi-barbarious emotional music' of jazz.[49]

In short, pamphlets and essays such as those of Sully, Lessing, McKenzie and Rowland displayed a deep concern about the disrupting effects of noise on societies' intellectual strength and cultural maturity. The higher classes, the refined mind and cultivated self-control were now thought to be threatened by the mechanical and non-mechanical sounds of the lower classes, the lowest emotions and brutal self-diffusion. With respect to some technologies, this transference of a traditional sound symbolism to new sounds seems illogical. The early automobile, for instance,

was the privilege of the rich rather than of the masses: to associate the noise of cars with the lower classes seems strange. Yet this only underlines the significance of the cultural symbolism of sound. Furthermore, it is important to note that the sounds of individually-owned cars and gramophones were less impersonal than those of trains and factories, enabling direct attacks on identifiable groups of people.

Even the machine itself came to be invoked as a metaphor of mind in order to underline the latter's refined and vulnerable character. According to Rowland, 'the avoidance of friction of the human senses is as important for the equable functioning of the mind as is the elimination of mechanical friction for the proper working of a dynamic machine';[50] and for McKenzie, the modern mind was ...

> ... a delicate instrument, the needle-indicator of which trembles and oscillates to the finest currents of thought and feeling. By culture and education we have acquired the sensibility of the artist or poet. And yet we continue to expose this poised and fragile instrument to the buffeting of a steam-hammer, to the shriek of a locomotive![51]

This situation was felt to be most acute in the cities. In the years between 1900 and 1914, the motorization of cities such as Hanover, Lessing's home base, was still moderate. In 1907, Hanover itself had 1472 motorcars – Germany as a whole had over 27,000 motorcars versus about 2 million horses used for transport.[52] Still, the density of traffic – the many horse-drawn vehicles, electric trams and motor-vehicles taken together – rapidly increased. Along a busy spot in Hanover in 1900, trams came by 850 times every 20-hour day, resulting in the production of sounds of brakes and metallic creaks of wheels in the curves of rails every 90 seconds.[53] Articles on noise in the popular press became common, and were part of a more general concern about an increase of nervousness as a consequence of the new urban sensory experiences enabled by motorized traffic.[54] And although the quality of the sound in the streets of London had improved by 1916, McKenzie claimed, being 'less clattering, less jarring, less varied' as a result of smoothly-surfaced roads such as asphalt, wood and pitch, of rubber tyres instead of iron-girt wheels, and of electric instead of steam engines, the noise had increased in quantity.[55]

> The roar of the traffic of motor-buses, taxi-cabs, and motor-cars is of a deeper, more thunderous, and more overpowering nature than in former days, principally because vehicles are heavier and are driven at a much greater speed.[56]

The irregular and unexpected sound of the motor horn, the sounds of change-speed levers of buses, and the sounds of trains such as 'the clank of the wheel at the end of each length of rail', all contributed to this din.[57]

Fleeing the city and seeking silence in rural life was not promoted as a solution, however. Nature, in contrast to the human-made environment, was considered to be without unpleasant sound, and rural as well as urban life was once thought to have been silent.[58] Yet noise was now felt to be

ubiquitous, even in the country. Lessing, for instance, tried to find tranquillity in villages, but felt haunted by sounds like that of the carousel, the steam-plough, threshing-floors, boilermakers, and all kinds of animal. Even in the most far-away valley of the Alps, he lamented, one would encounter a gramophone.[59] But technology itself was not seen as the bad genius. Of course, it had been 'left to scientific civilisation to fill the world with stridency'.[60] But no one asked society to refrain from technological progress. Even Lessing, socialist in political perspective, yet culturally conservative in many of his expectations with respect to modernization, had nothing against technology *per se*. He really believed that automobiles, motorcycles and airplanes were the vehicles of the future. Society *itself* had to be reorganized.

In line with their characterization that making noise was disruptive behaviour, and that noise indicated a degeneration of societal order and mental life, the noise-abating intellectuals saw education of the public as the most fundamental solution to the noise problem. Although the intellectuals considered all kinds of practical measures to be of help, they stressed that teaching the public how to behave was the best strategy to attain lasting results. In every school, Haberlandt wrote, an 11th commandment should be taught: 'Thou shalt not make noise'.[61] '[T]he only hope of ultimate reform', Rowland thought, 'would seem to lie with our schools, where the subject of general social deportment might well occupy a more important place'.[62] Much could be done, McKenzie claimed: 'But the victory will come all the sooner if public opinion can be educated'.[63] And Lessing's campaign focused on fostering 'societal conscience'.[64]

Such an education could be sustained by law. Sully pointed out that, since the ear, unlike the eye, had no natural defence, the law should recognize and more precisely protect the right to silence in one's own dwelling – by transforming certain noises into penal offences. More specifically, McKenzie wanted to prohibit the use of the motor-horn at night. Prohibitions of that kind were far from new. Municipal laws that restricted the shouting and crying of sellers in the streets and the barking of dogs date back to the 17th century, and laws against the blacksmith's hammer even to the 13th century.[65] Yet, as Lessing made clear for Germany, law was still inadequate to the abatement of most noises. Since noise could only be punished in cases where it was 'generally disturbing', 'unnecessary' and 'intentional', judgment was quite arbitrary. Moreover, the noise of machines could hardly be sentenced, since the noise of trains, trams and factories was supposed to arise from the 'nature' of things, and 'harm' only mattered in case of damage to 'possessions', thus not to one's fortitude, health and sleep.[66]

Other proposed solutions focused on a spatial reorganization and visualization of city life, with the help of new technologies. According to the German social psychologist and nerve specialist Willy Hellpach, the railway station of his day, anno 1902, was far less noisy than it had been before. This could be attributed, he argued, to 'visualization'. Many

'toxicating' aural signals – horns, whistles, shouts, jingles – announcing and accompanying the arrival of trains had been replaced by 'sober and non-obtrusive' inscriptions.[67] Furthermore, he welcomed the increasing separation of the home and the workplace, since the noises of manual workers such as the locksmith, cabinet-maker and cobbler were more disturbing to neighbours than the dimmed, continuous noise of a factory. The real causes of noise, he made clear, could be found in the things that had remained as they were: the narrow, dark streets through which the traffic squirmed. In the future city, the centre should only be accessible to silent and slow traffic aiming for business. New, broad roads should be planned at the periphery, and factories at the remote corners of the city. 'Today', Hellpach concluded, 'the best assistant of the nerve specialist is the *engineer*'.[68]

Lessing also suggested changes that implied reforms of public space. For car racing, he stressed, one should construct private roads instead of public ones. In contrast, the many awful noises of housekeeping in each separate apartment, could be diminished by centralizing housekeeping in new enterprises. Moreover, he considered the ringing of church bells at every private event of life to be the non-functional remainder of an age in which the individual had really been part of the community.[69] Corbin has also noted such resistance against collective bell-ringing, especially in the early morning, in late 19th- and early 20th-century France. He attributes this to a de-standardization of the rhythm of life, a consequence of the genesis of an active nocturnal life of parts of the urban population, another important context for the rise of anti-noise essays and noise abatement campaigns.[70]

Public space was also the topic of a treatise on city noise that Berlin's town-planning inspector produced as early as 1903. In complete contrast with Hellpach, it was precisely the separation of work and home, although rational in itself, which the inspector considered to be the cause of noise, since it was the by-product of the resulting increased transportation. Since he took this ultimate cause for granted, his solutions focused on diminishing the noise of the transportation facilities by proposing new materials and constructions for pavements, cars, wagons, trams, tyres, rails and rail-road crossings.[71] According to the Berlin inspector, the noise produced by man himself – shouting or the use of bicycle-bells and car-horns – was the most difficult to control. One could not give every citizen a personal policeman to check his behaviour, nor objectively judge the noise of their vehicles. Even worse, most people did not recognize the health hazard of noise, although noise damaged their nerves and shortened their sleep.[72]

Yet trying to control people's behaviour, especially on the road, became precisely the rhetorical heart of the campaigns that followed the first essays on noise, a result of the enduring conceptualization of city noise as a problem caused by disruptive and uncivilized behaviour. Even the introduction of noise measurement did not change the special place of public education among the proposed solutions. Again, practical improvements were on the agenda. Public education, however, remained to be seen as the crown of

noise abatement, as well as the straw at which to clutch in case success failed to come. How that education was modelled, and how the extent of its success relates to the symbolism of sound, will be the focus of the next section.

Noise Abatement Campaigns: The Need for a Noise Etiquette

A few months after the publication of Lessing's *Der Lärm*, the 'German Association for Protection from Noise' (*Deutscher Lärmschutzverband*) was founded – by Lessing himself. The Association became generally known as the 'Anti-Noise Society' (*Antilärmverein*) and published a journal called *Antirowdy: Right to Silence*. In New York, the *Society for the Suppression of Unnecessary Noise* started in 1906, whereas the London *Street-Noise-Abatement-Committee* started two years later.[73] France had a 'Society for the Suppression of Noise' as early as in 1928. The German Society of Mechanical Engineers (*Verein Deutscher Ingenieure*) raised a Noise Abatement Committee (*Fachausschuss für Lärmminderung*) in 1930. In the United Kingdom, the (national) *Anti-Noise League* was founded in 1933, followed by the Austrian 'Anti-Noise League' (*Antilärm-Liga Oesterreichs*) and the Dutch 'Sound Foundation' (*Geluidstichting*) in 1934, as well as the Dutch 'Anti-Noise League' (*Anti-Lawaaibond*) in 1937. The British named their journal *Quiet*, which the Dutch imitated with *Stilte*, a journal first published in 1938.[74]

By that time, most anti-noise campaigns had already been completed, both in Europe and beyond. The first wave of campaigns occurred between 1906 and 1914, the second wave presented itself in the first half of the 1930s. The societies and committees behind the campaigns did not become mass movements. As the British Anti-Noise League admitted in 1936: 'The interest taken by the public in the cause of the League has been disproportionately greater than the growth of its membership roll'.[75] The press coverage of their activities was, however, substantial, especially in the 1930s, when hundreds of newspaper and magazine articles accompanied the campaigns.

The rate of success of the early campaigns differed. Lessing's Anti-Noise Society had over a thousand members, primarily scholars, physicians and lawyers, and really hit the headlines. Yet, although the society attained some local successes, such as the introduction of new pavements in specific streets, and new ordinances for controlling the ways in which wood, iron, copper and the like were transported, it did not achieve any changes in national law, and was disbanded in 1914.[76] According to several historians, this was due to the society's élitist point of view. 'Tranquillity is distinguished' (*Ruhe ist Vornehm*) was its slogan. Such an approach did little to foster alliances between the Anti-Noise Society and, for instance, labour unions. Moreover, Lessing's society had far less to say about industrial noise than about the noise of traffic, which again reflected its élitist approach. Furthermore, Lessing's conviction that refined people were the most likely to suffer from loud sounds was ridiculed by the press. Members

of the Anti-Noise Society were portrayed as non-masculine hysterics. What's more, no sufficient measuring equipment was available to lend force to noise control measures, and World War I made noise abatement seem quite unimportant.[77]

As can be inferred from the work of the environmental historian Raymond Smilor, the early noise abatement campaigns in the United States were more successful. Just as in Europe, noise abators in the United States associated silence with 'civilization'.[78] However, noise was not merely seen as 'primitive', but also as 'inefficient'. Dembe has shown that noise referred to waste such as loss of productive power and deterioration of machines. What's more, noise in industry and offices threatened the powers of concentration of employees, and city noise in general undermined public health – a theme typical for the Progressive Era, in which urban reform was an important issue.[79] Public health became the focus of the New York City Society for the Suppression of Unnecessary Noise, raised by Julia Barnett Rice. Instead of lightening the burden of noise mainly on behalf of intellectuals, the New York Society first and foremost aimed at reducing noise for the sake of children and the sick, so as to promote processes of learning and recovery. It successfully campaigned for the creation of silence zones around hospitals and schools, for a law against unnecessary horn signals in shipping, and for the reduction of fireworks, both noisy and unsafe, on the Fourth of July. Such a focus on the protection of children and the sick facilitated obtaining support from the press and industry, since – apart from those of the fireworks industry – no vested interests were at stake. The same went for the focus on unnecessary noise – that is to say, noise that was not associated with technological progress. Yet the 'unrestricted use' of automobile signals and muffler cut-outs, the Society made clear, remained to be tackled.[80]

In the late 1920s and early 1930s, these early noise-abatement campaigns were followed by big campaigns of noise-abatement societies all over Europe and the United States. Now, the definition of noise as a costly threat to the health and efficiency of *all* citizens was common. Henry J. Spooner, of the London Polytechnic School of Engineering, said that future generations would look back on an ...

> ... age of folly vulgarized by an absence of quietude and repose, and notorious for uncontrolled devastating din that tortured the thinkers, deprived countless invalids and workers of recuperative sleep, impoverished owners of traffic route properties, increased the overhead costs in modern business and shortened the lives of countless sufferers.[81]

Besides, the focus on traffic noise became even more predominant than it had been before World War I. Since street noise already had a bad reputation, it was an obvious topic on which to focus the first noise measurements. Such measurements brought the loudness of traffic noise into the limelight, and the first noise surveys did the same to the annoyance traffic noise evoked. What's more, the topic of traffic noise allowed noise-abatement societies to enter into alliances with traffic societies, as will be

illustrated below. Yet even with respect to traffic noise, public education remained on top of the list of solutions. After all, noise was still thought of as being 'vulgar'.

Let me first elaborate on the changes concerning the measurement of noise. According to Birkefeld and Jung, the definition of noise as 'unwanted sound' goes back as far as the early Middle Ages, at least in general dictionaries.[82] Yet within acoustics, 'noise' was initially thought of as nonperiodic, irregular vibrations, in contrast to the periodic soundwaves of musical tones. Not until the 1920s and 1930s did the definition of noise as 'unwanted sound' become common among acoustical engineers. This happened, Ronald Beyer claims, because engineers dealing with telephone reception 'found that the presence of other sounds interfered with such reception and began calling these extraneous sounds noise', as well.[83]

At about the same time the measurement of sound drastically changed. The intensity of sound had been very difficult to measure because of the extremely low energy levels emitted. Only after the development of telephone technology, which enabled the separation of different frequencies, and of the radio valve, which made it possible to amplify small energy levels, sound intensity became easier to measure.[84] Subsequently, both telephone technology and experimental psychology contributed to the establishment in 1925 of the 'decibel' (deci-Bell) as the unit of loudness. Telephone technology contributed because of its search for a unit for measuring the transmission efficiency of telephone circuits, and experimental psychology because it showed the dependence of the sensation level of sound on the logarithm of the sound's intensity, at least for those frequencies for which the ear is relatively sensitive.[85] The threshold limit of a tone of 1000Hz became established as the zero-point of 0 decibel (Db), and two powers were said 'to differ by n decibels where $n = 10 \log P1/P2$. An increase of 1 decibel corresponds to a 26 percent increment in power or intensity, 10 decibels to a tenfold increase, 20 decibels to a hundredfold increase and so on'.[86]

The first surveys of city noise were published between 1926 and 1930, and had been executed in London, Chicago and New York with help of audiometers (or subjective noise meters) and, shortly afterwards, of acousti-meters (or objective noise meters). In case of an audiometer, the loudness of a tone was measured by changing the intensity of a reference tone until it was felt to be masked by the tone to be measured. The objective noise meters were basically made up of a microphone, an amplifier and an indicating meter, which made the measurement of loudness a purely physical issue. A next step was the development of noise-meters for complex tones. Although there were still significant difficulties – for instance, noise meters could not exactly follow noises that fluctuated rapidly – the first noise surveys, of which those of 1929–30 in New York were the most extensive, were reviewed by Rogers Galt in 1930 in the *Journal of the Acoustical Society of America*. Galt's figures, graphs and tables became widely known, and showed up in popular as well as scientific publications on noise all over the Western world.[87] Galt underlined that

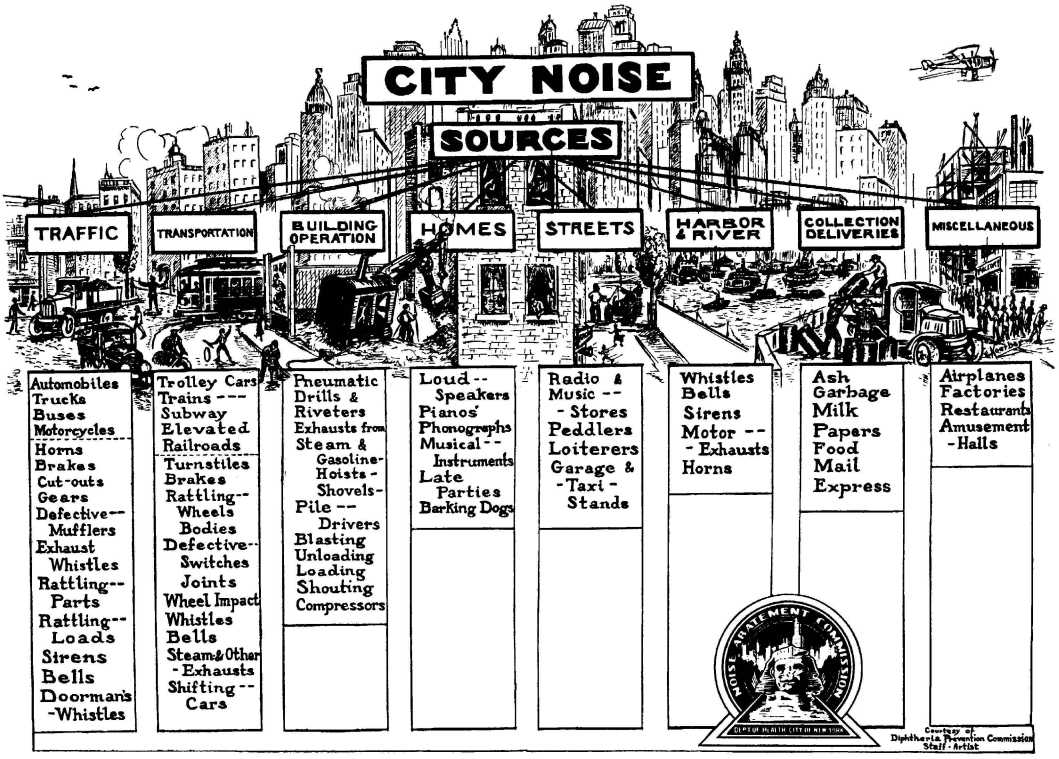
noise was not the same as annoyance, since circumstances such as the frequency of occurrence of a specific noise, its component frequencies, the noise being steady or intermittent, being regarded as necessary or not, were also significant. In other early publications, remarks of the same kind can be found. Along with such remarks, however, loudness levels increasingly became the sign of 'how bad' the situation was.[88]

In 1929, complaints of citizens urged the New York Commissioner of Health to appoint a commission to study city noise and the means of abating 'the diabolical symphony' of 'our present mechanical age'.[89] Its members represented the worlds of engineering, medicine, acoustics, the police and city administration, and the automobile and telephone industries. The commission produced two reports and started a huge anti-noise campaign in which the first report, and the press responses it evoked, were considered to be important steps in creating public consciousness of noise. According to the first report, the noise nuisance varied from the use of loudspeakers outside shops, the screeching of brakes and the abuse of automobile klaxons, to the use of muffler cut-outs on motor boats, the noises of milk and ash cans, of pneumatic drills, of the turnstiles in subways and of elevated trains. A chart on the inside cover of the report provided an overview (see Figure 1). The commission made clear that, up to the recent past, the noise of the machine-using age had been proudly perceived as the sound of progress and prosperity. Now, however, noise had to be considered as a serious health hazard.[90]

The clamour of the city, the report said, impaired the hearing of New Yorkers and induced harmful strain upon the nervous system that led to 'neurasthenic and psychasthenic states', to loss of efficiency of workers and thinkers, and to disturbed sleep.[91] The metropolitan newspapers published a questionnaire, so as to map out the roar of the city. Over 11,000 people responded and reported to be annoyed most by the noise of traffic, transportation and radio.[92] Notwithstanding the latter, commission members arranged radio talks, so as to 'arouse public consciousness to the evils of noise and the advantages of a quieter city'.[93] Some practical progress in noise abatement was made with respect to the unnecessary whistling in the harbour, the blowing of car horns and the use of open cut-outs by mail trucks, as well as to the construction of more silent turnstiles. Moreover, amendments in the Sanitary Code and the Code of Ordinances had been passed so as to control the use of loudspeakers. According to Dembe, the New York anti-noise campaign, by stimulating research and by raising public consciousness, also indirectly furthered the postwar financial recognition of industrial hearing loss.[94] The second New York report, however, published in a limited edition in 1932, stressed the difficulty of really solving the noise problem. Suffering from the Economic Depression, the commission was dissolved in the same year.[95]

The second New York report made clear that the commission could oversee research and propose methods of noise abatement, but had been unable to prompt the city authorities to action (beyond those mentioned above). The report stressed on almost every page, however, that the biggest

FIGURE 1
Sources of City Noise



Source: Brown et al. (eds), op. cit. note 36, inside cover.

issue and problem was public consciousness: 'The responsibility for city din rests less on the machine than on public apathy'. In a dramatic tone, the report told a story similar to the ones presented by Leo Marx's 19th-century literary men, except for the last, crucial, turn; as the report said:

> One hundred and fifty years ago, the world was like a quiet valley. ... One day there was an ominous rumbling on the surrounding hills and a horde of barbarian machines poured down on the quiet valley. With steam whistle war whoops and the horrible clanking of iron jaws they came. ... Resistance was vain, for how could hand power compete with steam? ... But the swift of mind fled to the further hills where they tried to rebuild the lost world in their dreams. ... Every aspect of the machine being considered marvellous, noise also became a minor god. ... At last, however, the swift of mind returned from the ivory towers they had built in the hills and took over the task of recivilizing the new machine age. ... But though many battles are won, the goal still lies far ahead. ... We cannot expect quiet until the millions realize they have sold their birthright for a radio and an automobile. Therefore, the only permanent contribution the Noise Abatement Commission can make is to assist in educating the people.[96]

So not a pastoral landscape was sought for, but a quiet city.[97] And not by throwing out the radio and the automobile, but by changing public opinion. Even law, in the form of a standard noise ordinance, could only be effective if people knew that noise was unhealthy, inefficient and often unsafe. Therefore, the police should act as an educational rather than a punitive body. Moreover, people should behave according to a Noise Etiquette for Automobile Owners. They should not use their horns to summon people within doors, but only blow their horns when necessary to avoid accidents. Furthermore, they should buy a silent car, shift gears silently, investigate unusual noises, have squeaking brakes relined and the car regularly greased, make sure that the muffler functioned properly and have rattles corrected.

In Europe, the noise campaigns likewise focused on traffic and transportation. In the United Kingdom, these led to the 1934 amendment of the Road Traffic Act which prescribed a silencer that reduced the noise of the exhaust, prohibited the sale and use of motor vehicles and trailers that caused excessive noise as a result of defects, lack of repair, faulty adjustment or faulty packing of the load, and banned the sounding of motor horns between 11.30 p.m. and 7 a.m. in built-up areas. A few years later the Anti-Noise League made sure that the Highway Code no longer contained 'any positive recommendation to sound the horn'.[98] The same League encouraged 'those concerned in the design and the manufacture of noisy machines toward better manners as well as more efficient science', and organized an exhibition so as to make the public familiar with artefacts varying from noiseless typewriters, floating floors and ear plugs to quietly running electric motors, silenced breakers, exhaust silencers and pneumatic railcars.[99] Revealingly, one of the advertisements in the exhibition catalogue stated that road drills could 'be effectively silenced without loss of power'.[100]

In Paris, the blowing of horns came to be prohibited after the Society for the Suppression of Noise had addressed itself to the Prefect of Police. An educational campaign was also started to reduce 'the jay-walking habits of pedestrians'.[101] Italy banned the use of the horn at night in 1934 and, in Rome from 1935 onwards, even during the day. By 1937, Germany had made silencers obligatory; moreover, engine noise needed to stay below a maximum loudness, 'hooters' had to have an 'approved pattern' and 'sound of unvarying pitch', and the use of horns for other purposes than warning was punishable.[102] In the 1930s, cities such as Wiesbaden, Stuttgart, Zürich, Stockholm, Milan, Rome, Antwerp, Brussels and The Hague all organized 'silence weeks' or 'traffic weeks', to educate the public in reducing the deafening use of car horns.[103]

In the next section, the character and consequences of such campaigns will be more closely examined by focusing on the silence campaigns in the Netherlands, where many of the original sources have been preserved. From what has been already presented, however, it is already clear that symbolism of sound partly modelled the campaigns, as well as the response to those campaigns. For instance, the association between silence and social distinction guided the early German campaign, which focused on creating silence for the bourgeois élite. Despite the many practical proposals advocated during that campaign, promoting the respectability of silence was seen as crucial for noise abatement, whereas industrial noise had no priority. This in turn hampered alliances with labour unions, and inspired opponents to counter the anti-noise campaign with another association: that between noise sensitivity and femininity. Neither the increasing concern with noise as a general health hazard negatively affecting efficiency, nor the introduction of measurement apparatus, however, changed the rhetorical focus of anti-noise societies on public education. Making noise was still seen as a sign of being uncivilized, of having no manners. In a more general sense, noise was thought to have been welcomed because of the positive connotations, such as progress and power, that loud sounds possessed.

As the New York Noise Abatement Commission found out, breaking such symbolic links was very difficult. One of the press responses to its campaign had been the following: 'Isn't it precisely that it is the big noise, the detonation of our national dynamite, that attracts the big crowds which make New York?'.[104] And in London, a comment on the first annual report of the London Anti-Noise League claimed that the noise of machines would always 'find out a way of returning', since the 'joy of life expresses itself in a crowded chorus'.[105] The Italian Futurists, indeed, adored city noise as the symbol of the dynamics of modern life, and even introduced city noise into music.[106]

What *did* succeed, as we will see, were exactly those proposed changes in traffic control and city planning that contributed to a new rhythm of city life. As Anthony McElligott made clear in a recent, highly original interpretation of Walter Ruttmann's film *Berlin: Symphony of a City* (1927), the spectacular image of the fast-flowing traffic in that film ...

> ... might appear chaotic, but it never is. Instead its constituent and apparently anarchic parts are constantly configured into a single pulsating flow of order as a result of an imperceptible traffic plan, and the regulating presence of the traffic police, who together ensure that the underlying structure of urban-based capitalism remains intact.[107]

How such a flow of order was reached in the Netherlands, and how such can be understood in terms of the symbolism of sound, is the topic of the next section.

Silence Campaigns in the Netherlands: Creating an Urban Rhythm

In Holland, the official first steps towards studying and fighting the noise problem were taken by scientists and engineers.[108] The first president of the Dutch Sound Foundation was Adriaan Daniël Fokker, a professor in technical physics.[109] The aim of the Sound Foundation was to manage, and to spread knowledge about, all kinds of sound issues. Since noise had a bad influence on man's ability to work, society was in need of scientific research so as to indicate the maxima of allowed sound levels, and to silence technologies such as vacuum cleaners. The design of prescriptions for buildings, inspection and measurement of construction material, non-commercial advice and public education were other tasks of the Sound Foundation.[110] After a few years, a separate Anti-Noise League was established, to support local noise-abatement committees and to help the Foundation financially, thus enabling the latter to focus on research.[111]

In both 1934 and 1936, the Sound Foundation organized Anti-Noise Conferences, in cooperation with the Royal Dutch Automobile Club (*Koninklijke Nederlandsche Automobiel Club*).[112] According to Fokker, conferences such as these were a complaint against modern culture. To fight the 'demon' of noise, one had to set out 'the ideal of the expert professional who silently knew to control his noiseless machine' against the 'noise vulgarian' and 'motor yokel' who tried to impress others by making noise.[113] The despised blowing of car-horns, most contributors made clear, had to be eliminated first. Car-owners were used to blowing their horns at every side street, and expected the question 'Did you blow?' whenever they were involved in an accident. New rules, however, such as a ban on acoustical signals at night, could put an end to this. Henceforth, cars should slow down and signal optically by using their spotlights. Furthermore, it was necessary that pedestrians and cyclists behaved differently. The former had to cross intersections in a straight path and to use pedestrian crossings, whereas the latter should really stay at the right side of the road. As had been proved abroad, such rules even reduced the number of accidents, provided the rules were adopted nation-wide. Thus, if society replaced aural forms of traffic control by visual and spatial ones, silence, safety and order would follow.

Likewise, quiet streets could be realized by a new spatial design. City and traffic noise, one contributor claimed, were almost 'directly proportional to the age of the city. . . . The narrower the streets, the more winding their plans and the more unsurveyable their angles, the bigger . . . the disturbance of traffic noise'.[114] In the old city, noise-producing industries were loosely scattered over the city area. Obsolete means of transport, such as the electric tram, blocked the normal traffic. Therefore, the town plan needed modernization. The separation of industrial and residential areas, restraint on 'ribbon' development, and the reduction of angles and bends in roads, were all of the utmost importance.

Improvements in the sound levels of technological artefacts themselves, for instance by constructing silencers, new horns and alternative ways of loading, were also discussed. Yet they were not the centre-stage issues at the conferences. One engineer talked about the many sounds of cars, such as rattling, puffing, whistling, clicking, tapping, crashing, screeching, howling, crying, grinding, cracking, sneezing and whizzing, and asserted that an acoustical analysis of motor sounds could reveal deviations from the normal functioning of machines before they could be seen.[115] His auditory focus was an exception, however. The production of orderly town plans and – above all – orderly behaviour held priority. The latter should be achieved by orchestrating silence campaigns.

Such silence campaigns were organized in 1935–36 in Breda, The Hague, Rotterdam, Groningen and the south of Limburg, often in cooperation with the police and traffic organizations. During 'silence weeks', 'silence months' and 'silence exhibitions', thousands of pamphlets, placards and flags were distributed, and dozens of newspaper articles, radio talks and even newsreels in cinemas covered the campaigns. The basic consideration was to familiarize civilians with the idea that they had to *look out* before they blew their horns, or before they forced others to blow their horns: 'Use your eyes instead of your horn', one pamphlet said. Just as railway stations had replaced the infernal noise of bells and whistles by optical signals, streets should likewise become quiet. Hence people should watch out, stay right, slow down, use silencers, and were summoned to consider their motor as a means of transportation, instead of a machine for testing other people's eardrums. The back page of one pamphlet even revealed a prize contest, eventually won by a musician who stressed that all traffic participators could contribute to decreasing the din of horn blowing.[116] 'Orderly Traffic Promotes Silence' was one of the slogans of the campaigns.[117]

So chaos meant noise and order meant silence – conceptual combinations with a long history, as we have seen. Yet the focus on public street behaviour and traffic control was not just caused by this cultural background alone. Initially, the Sound Foundation did not know which subject was most appropriate to start campaigning against. According to Fokker, such a subject needed to be tangible, so as to raise public attention. Moreover, the Sound Foundation discovered that the Royal Automobile Club already had plans for the organization of 'silence weeks'. To the

Automobile Club, such events represented a chance to strengthen their competitive position, compared to the 'General Dutch League of Cyclists' (*Algemene Nederlandse Wielrijders Bond*). At the same time, silence weeks were a form of propaganda for the automobile in general, since orderly behaviour of all traffic participants literally cleared the way for the car. What's more, cooperation between the Royal Automobile Club and the Sound Foundation meant financial backing of the latter by the former. Such factors facilitated the choice to campaign against traffic noise.[118]

Indeed, the campaigns – at least temporarily and locally – diminished the use of car horns. In The Hague, for instance, the police counted the number of horn blows on several days at three locations between 8 and 9 in the morning, between 12 noon and 2 in the afternoon, and again between 4 and 6 in the afternoon. Before the silence week, they counted over 5300 passing buses, cars, trucks and motors, and over 5400 signals. A month after the silence week, over 5100 vehicles passed and a little over 2500 horns blew. No comparable figures were gathered in Rotterdam, but 'progress' was observed, and locally the noise was 'notably reduced'.[119] Furthermore, the Motor and Bicycle Regulation was renewed in 1937, and henceforth included maxima with respect to the noise volume of motors and horns, as well as a prohibition on the use of the horn at night. In 1934, a British industrial psychologist claimed that such a prohibition in the United Kingdom had been 'spontaneously followed' by a 'striking reduction in the frequency of the hoot of the motor-car horn during the day'; and in the same year, the Stuttgart police reported 'a general calming of the traffic', as well as a relative 'drop of the number of casualties'.[120] It may not have been that easy everywhere. In Breda, the campaign had less success. According to a member of the Sound Foundation, this was partly due to Breda's narrow streets. A newspaper, however, stressed that policemen just outside Breda kept instructing motorists to sound their horns at every crossing.[121]

Notwithstanding such problems, the use of the motor-car horn seemed to have been generally reduced. Other changes are also worth mentioning. According to a Dutch conference report, the behaviour of pedestrians did not show improvement, but that of bicyclists, motor-cyclists and motorists certainly did.[122] In general, in Holland and elsewhere, traffic control became more visualized by the use of spotlights at night, and by the introduction of optical train signals.[123] And as McElligott made clear for Berlin, the city traffic came to be 'collectively directed by traffic signs, regulations, and police hand signals'; commuters were circulated by rail, tram and roads, 'movements forming a grid that contained and controlled the energies of the metropolis'.[124] Such moves fostered economic well-being and safety, and at the same time created rhythm out of chaos, thus partially reasserting human control over events, in a way comparable to the rituals described by anthropologists for more ancient or remote cultures. Yet the form of control was new, and was part of what Thomas P. Hughes has characterized as the 'values of order, system, and control' that engineers

embedded in machines, and which 'have become the values of modern technological culture'.[125]

Activities of the Dutch anti-noise movement, starting in the late 1930s, such as those concerning noisy dwellings and the noise of trams, aircraft and 'stamping machines of post offices', were far less successful than the campaigns fighting traffic noise. This was due to a lack of organizations to associate with, to the economic crisis and, finally, to the war. In 1940, the Dutch Anti-Noise League stopped its activities and slumbered until a revival in the 1970s.[126]

Conclusions: A Sound History

The many manifestations of technology in the late 19th and early 20th century drastically changed the sonic environment of Western society. The sounds of factories, trains, trams, automobiles, buses, motor-cycles, aircraft, telephones, radio, pneumatic drills, steam-hammers, and of thousands of hooters, brakes, mufflers and gear levers, accompanied those of church bells, whips, street musicians, carpet beating, milk cans and yelling people.

It is my claim in this paper that the S&TS constituency should listen to the sound of technology, since sound is an aspect of technology that has a history of dispute loaded with cultural symbolism, and since studying such a symbolism of sound opens up a new entrance into unravelling and understanding modes of response to technological change. The way in which, out of the technological sounds mentioned above, the 'noise problem', the proposed solutions to it, and the responses to such solutions, came to be defined and articulated has been deeply influenced by recurrent patterns in a long-standing symbolism of sound. Such patterns in the cultural meaning of noise and silence became transferred to the sounds of new technologies, and structured the choice of metaphors through which people tried to carve out and grasp the noise problem. Moreover, such general lines account for some phenomena in the noise abatement episode of 1900–40 which seem to be incomprehensible at first sight, yet become understandable as manifestations of a recurring symbolism of sound.

The basic pattern of such a symbolism was, as anthropologists and historians have shown, that loud sounds, if positively evaluated, have been attributed with characteristics such as power, strength, progress, prosperity, energy, dynamics, masculinity and control. Yet the very same sounds have, in cases where they were unwanted and therefore labelled as 'noise', been continually thought of as a sign of a deliberate disruption of societal order, often by those lower in the hierarchy. The kind of order thought to be threatened varied over time and over the kinds of people complaining. Noise could threaten the pastoral idyll of 19th-century American literary men; society's intellectual strength, cultural maturity and cultivated self-control of which the late 19th- and early 20th-century European intellectuals spoke; and the economic efficiency, health and safety the noise abators of the 1920s and 1930s wanted to protect. Noise referred to

conflict and complexity, rudeness, wildness, primitiveness, irrationality, intimidating behaviour and revenge. Notwithstanding such variety, noise meant chaos, silence meant order, and rhythm meant control within and over societal life. Consequently, human behaviour and societal organization were seen as the first causes of the dissonance, as well as the starting-points for the restoration of harmony.

Solutions were sought for in correspondence with this pattern, as well as with specific contexts. Whereas the 19th-century American literary men could still think of land in which the pastoral ideal could be restored by using technology to create a cultivated garden, the 20th-century European and American city dwellers had no virgin land or tranquil village left, and sought a quiet city. Such a silence was pursued within a context of individualization of the possession of noise-sources (the automobile, the gramophone, the radio), a de-standardization of nocturnal life, a general discourse on the nervousness of city life, a concern over traffic safety, urban reform and refinement. Therefore, public education through campaigns, traffic control, city planning and new transportation constructions were seen as the most important solutions: thus an attempt was made to create order by civilizing the masses, and by creating a new urban rhythm. Moreover, in line with the basic notion of noise as disruptive behaviour, teaching the public a noise etiquette was, more than anything else, seen as the alpha and omega of noise abatement.

The symbolism of sound described above explains why intellectuals complained about the car and blamed the working classes for making noise at one and the same time, although the automobile started out as the vehicle of the rich. It also explains why education kept its rhetorical predominance among the proposed solutions, even when measurement procedures 'objectified' noise, and engineers introduced new means of noise reduction. After all, noise abators made clear, those who did not silently control their machines, displayed vulgarity. Last but not least, the symbolism of sound clarifies the responses to the noise abators' campaigns: the abators' 'refinement' came to be ridiculed as femininity, and they were, not surprisingly, unable to find alliances among the groups they implicitly or explicity blamed, or to the problems of whom (such as problems caused by industrial noise) they paid less attention. On the other hand, abating the positive connotations of loud sounds, such as 'dynamics' and 'strength', turned out to be extremely difficult.

Despite the visible changes in traffic control, transportation constructions and city planning, modern society did not become quiet. According to Raymond Smilor, noise abators tragically overlooked the quantitative increase in traffic.[127] Finally, every new invention created new sounds, which again and again became the topic of heated controversy.

Notes

I would like to thank Manuel Stoffers for bringing to my notice several of the German sources, Joke Spruyt and Geert Somsen for correcting the English, and Ernst Homburg,

Hans-Joachim Braun, Trevor Pinch, Rein de Wilde and the anonymous referees for their comments on this paper.

1. Raymond Murray Schafer, *The Soundscape: Our Sonic Environment and the Tuning of the World* (Rochester, VT: Destiny Books, 1994); originally published as *The Tuning of the World* (New York: Knopf, 1977).
2. Ibid. (1994), 272.
3. For music, technology and noise, see: Hans-Joachim Braun, 'Technik im Spiegel der Musik des frühen 20. Jahrhunderts', *Technikgeschichte*, Vol. 59, No. 2 (1992), 109–31; H.-J. Braun, ' "I Sing the Body Electric". Der Einfluss von Elekroakustik und Elektronik auf das Musikschaffen im 20. Jahrhundert', *ibid.*, Vol. 61, No. 4 (1994), 353–73; Karin Bijsterveld, 'A Servile Imitation: Disputes about Machines in Music, 1910–1930', in H.-J. Braun (ed.), *'I Sing the Body Electric': Music and Technology in the 20th Century* (Hofheim, Germany: Wolke, 2000), 121–34; Douglas Kahn, *Noise, Water, Meat: A History of Sound in the Arts* (Cambridge, MA: MIT Press, 1999); Nicholas Spice, 'Een gat om in te duiken. Over muziek en technologie', *Nieuw Wereldtijdschrift*, Vol. 13, No. 3 (1996), 58–65. There is also a fast-growing body of literature on the history of electronic and mechanical instruments: see, for instance, Braun (2000), op. cit.; Elena Ungeheuer, 'Ingenieure der Neuen Musik. Zwischen Technik und Ästhetik. Zur Geschichte der elektronischen Klangerzeugung', *Kultur & Technik*, Vol. 15, No. 3 (1991), 34–41. For recent literature on the sound-movie, the phonograph, radio and recording explicitly taking account of sound, see: James P. Kraft, 'Musicians in Hollywood: Work and Technological Change in Entertainment Industries, 1926–1940', *Technology & Culture*, Vol. 35, No. 2 (April 1994), 289–314; Emily Thompson, 'Machines, Music, and the Quest for Fidelity: Marketing the Edison Phonograph in America, 1877–1925', *The Musical Quarterly*, Vol. 79, No. 1 (1995), 131–71; Douglas Kahn (ed.), *Wireless Imagination: Sound, Radio, and the Avant-Garde* (Cambridge, MA: MIT Press, 1992); Michael Chanan, *Repeated Takes: A Short History of Recording and its Effects on Music* (London & New York: Verso, 1995). A recent example from the domain of cultural studies is: Paul du Gay, Stuart Hall, Linda James, Hugh Mackay and Keith Negus, *Doing Cultural Studies: The Story of the Sony Walkman* (London: Sage, 1997). Perhaps the many studies into the history of the telegraph and the telephone could also be mentioned here. However, many of them do not concentrate on sound, but on changes concerning time, space and social behaviour. Certainly relevant is research into the history of acoustics, although often 'internalist': see, for instance: Frederick V. Hunt, *Origins in Acoustics: The Science of Sound from Antiquity to the Age of Newton* (New Haven, CT & London: Yale University Press, 1978); Paul N. Edwards, 'Noise, Communication, and Cognition: The Harvard Psycho-Acoustic Laboratory and The Second World War' (paper for the Cheiron Conference, Brunswick, Maine, 11–13 June 1987). Less internalist work on acoustics will be mentioned below.
4. Ruth Schwartz Cowan, 'How the Refrigerator got its Hum', in Donald MacKenzie and Judy Wajcman (eds), *The Social Shaping of Technology* (Milton Keynes, Bucks.: Open University Press, 1st edn, 1985), 202–18, reprinted from Cowan, *More Work for Mother: The Ironies of Household Technology from the Open Hearth to the Microwave* (New York: Basic Books, 1983), 127–45; Leo Marx, *The Machine in the Garden: Technology and the Pastoral Ideal in America* (London & New York: Oxford University Press, 1964).
5. Marx, ibid., 29.
6. Peter Bailey, 'Breaking the Sound Barrier: A Historian Listens to Noise', *Body & Society*, Vol. 2, No. 2 (1996), 49–66, at 49 and 55. I should like to thank Eddy Houwaart for drawing my attention to this article.
7. Ibid., 52–53.
8. Schafer, op. cit. note 1, 76 and 51. For the relation between religion and noise, see also: Winfried Menninghaus, 'Lärm und Schweigen: Religion, moderne Kunst und das Zeitalter des Computers', *Merkur*, Vol. 50, No. 6 (June 1996), 469–79.

9. Schafer, op. cit. note 1, 76.
10. Allard E. Dembe, *Occupation and Disease: How Social Factors Affect the Conception of Work-Related Disorders* (New Haven, CT & London: Yale University Press, 1996), 195, 203 and 211.
11. Hans-Joachim Braun, 'Lärmbelastung und Lärmbekämpfung in der Zwischenkriegszeit', in Günther Bayerl and Wolfhard Weber (eds), *Sozialgeschichte der Technik: Ulrich Troitzsch zum 60. Geburtstag* (Münster: Waxmann, 1998), 251–58.
12. Alain Corbin, *Les cloches de la terre: Paysage sonore et culture sensible dans les campagnes au XIXe siècle* (Paris: Albin Michel, 1994); republished as *Village Bells: Sound and Meaning in the Nineteenth-Century French Countryside* (London: Macmillan, 1999), quotes at 159.
13. Ibid. (1999), 290.
14. Paul Stoller, *The Taste of Ethnographic Things: The Senses in Anthropology* (Philadelphia: University of Pennsylviania Press, 1989), 110 and 121.
15. William H. McNeill, *Keeping Together in Time: Dance and Drill in Human History* (Cambridge, MA: Harvard University Press, 1995), 152.
16. Mieke Zijlmans, 'Kopen met je oren', *De Volkskrant* (12 October 1996), W17. See also: Judy Wajcman, *Feminism Confronts Technology* (Cambridge: Polity Press, 1991), 104.
17. Harry Cooke Cushing, Jr, *The Electric Vehicle Handbook* (New York, 11th edn, 1923), 6; cited in: Gijs Mom, *Geschiedenis van de auto van morgen: Cultuur en techniek van de elektrische auto* (Deventer: Kluwer Bedrijfsinformatie, 1997), 475. According to Mom (ibid., 213), opponents of the electric car even blamed the vehicle's 'noiselessness' for causing more accidents than the gasoline, since pedestrians could not hear it coming.
18. Clay McShane, *Down the Asphalt Path: The Automobile and the American City* (New York: Columbia University Press, 1994), 169.
19. Antero Honkasalo, 'Environmental Noise as a Sign', *Semiotica*, Vol. 109, Nos 1/2 (1996), 29–39, at 32–33.
20. Paul van Emmerik, 'Muzikale ecologie', *Tijdschrift voor Muziektheorie*, Vol. 3, No. 1 (1998), 52–59, at 54; Wouter Buikhuisen, 'Brozems: een nieuwe lente, een nieuw geluid?', *Tijdschrift voor Sociale Geneeskunde*, Vol. 47, No. 4 (14 February 1969), 7–12, at 9.
21. Anthony Jackson, 'Sound and Ritual', *Man*, Vol. 3 (1968), 293–99, at 295–96.
22. Mary Douglas, *Reinheid en gevaar* (Utrecht & Antwerpen: Het Spectrum, 1976); originally published as *Purity and Danger: An Analysis of Concepts of Pollution and Taboo* (London: Routledge & Kegan Paul, 1966).
23. For a case study of its application to modern laboratory science, see the paper preceding mine in this issue: Cyrus C.M. Mody, 'A Little Dirt Never Hurt Anyone: Knowledge-Making and Contamination in Materials Science', *Social Studies of Science*, Vol. 31, No. 1 (February 2001), 7–36.
24. See, for instance, Arnold Labrie, *Het verlangen naar zuiverheid: Een essay over Duitsland* (Maastricht: Rijksuniversiteit Limburg, 1994). The *Kultur- und Lebensreformbewegung* comprised *Lebensphilosophie*, theosophy, naturopathy, the total abstinence movement, vegetarianism, anti-vivisectionism, the garden city movement, race hygiene, naturism and youth culture.
25. Peter Burke, 'Notes for a Social History of Silence in Early Modern Europe', in his *The Art of Conversation* (Ithaca, NY: Cornell University Press, 1993), 123–41. See also Bailey, op. cit. note 6, 53–54.
26. Anne Carson, *Glass, Irony and God* (New York: New Directions, 1992), 127.
27. Burke, op. cit. note 25, 136.
28. As to the trend towards self-control with respect to speech – and other forms of bodily noises – Burke naturally refers to the work of Norbert Elias: Burke, op. cit. note 25, 140. See also Bailey, op. cit. note 6, 56.
29. Burke, op. cit. note 25, 140–41.
30. Bailey, op. cit. note 6, 55.
31. Constance Classen, for instance, argues that *oral* cultures – oral in terms of the dominant form of communication – are not always *aural* cultures. She gives examples

of oral cultures that 'symbolically orient themselves by temperature', by smell or by colour. Moreover, Classen shows that the 'standard ranking' of the senses in Western culture, in which sight occupied 'the highest position, followed by hearing, smell, taste and touch', had originated from Aristotle. See Constance Classen, *Worlds of Sense: Exploring the Senses in History and across Cultures* (London & New York: Routledge, 1993), 135, 3. For other work on the senses, see also Paul Rodaway, *Sensuous Geographies: Body, Sense and Place* (London & New York: Routledge, 1994), and Diane Ackerman, *A Natural History of the Senses* (New York: Vintage Books, 1991). However, Ackerman's book is more personal, less historical and only generally documented.

32. Jacques Attali, *Noise: The Political Economy of Music* (Manchester: Manchester University Press, 1985), 3. See also: Classen, op. cit. note 31, 11; Schafer, op. cit. note 1, 128. Even Schafer's notion of 'soundscape', Paul Rodaway has observed, has – through its links with 'landscape' – visual connotations, such as the static image and the 'privileged position' that may lead one to forget that the '[a]uditory experience is far more dynamic [than the visual experience]', and that 'the sentient participates within the sonic environment': Rodaway, op. cit. note 31, 86–87.
33. Moreover, within the culture of 17th-century science, at least in England, the age-old topos of science and solitude became employed anew by stressing the importance of the 'isolated individual in direct contact with reality' for the authentic discovery – not the legitimation – of truth: see Steven Shapin, ' "The Mind Is Its Own Place": Science and Solitude in Seventeenth-Century England', *Science and Context*, Vol. 4 (1991), 191–218. Such a stress on solitude probably meant that silence was highly valued, too.
34. That is not to say that there are no other ways of studying the relation between sound and technology than the one chosen in this paper. It may be interesting, for instance, to study how engineers listen to and acoustically analyze the artefacts they work with. Moreover, scholars who study technology might focus on the genesis of differences in the sound of technological artefacts. For instance, Schafer observes that the American telephone, at least in the 1970s, had a single ring, whereas the British telephone had beats of rings followed by silences; intervals between such beats varied from well over three seconds in New Zealand to ten seconds in Sweden: Schafer, op. cit. note 1, 242. Studying the causes and consequences of such a variety in the sound of technological artefacts could be a new way of studying how technology and culture co-evolve.
35. Quotations from Marx, op. cit. note 4, at (in order) 16, 9 and 219.
36. In 720 BC, the Greek colony Sybaris in Italy prohibited industrial noises in residential areas: see Edward F. Brown, E.B. Dennis, Jr, Jean Henry and G. Edward Pendray (eds), *City Noise: The Report of the Commission Appointed by Dr Shirley W. Wynne, Commissioner of Health, to Study Noise in New York City and to Develop Means of Abating It* (New York: Noise Abatement Commission, Department of Health, 1930), 6, 285–86. With respect to ancient Rome, several complaints about traffic noise are documented: see Schafer, op. cit. note 1, 190, and J.K. Nieuwenhuizen, *Stilte Alstublieft* (Eindhoven: Technische Hogeschool, 1969), 4.
37. Of an even earlier date was the disturbance felt by Kant, who hated the singing in the prison near his house, and Goethe, who displayed a deep dislike for the barking of dogs: 'kläffend zerreist es mein Ohr'. For Kant, see Herman Parret, 'Kant over muziek', *Restant*, Vol. 19, No. 2/3 (1991), 753–76, at 762; for Goethe, see his *Roman Elegies*, quoted in James Sully, 'Civilisation and Noise', *The Fortnightly Review*, Vol. 24 (1878), 704–20, at 706.
38. Arthur Schopenhauer, 'Over lawaai en luidruchtigheid', in *Er is geen vrouw die deugt* (Amsterdam: Arbeiderspers, 1974), 156–60, at 157; originally published as 'Über Lärm und Geräusch', in *Parerga und Paralipomena, kleine philosophische Schriften* (Berlin: A.W. Hahn, 1851); translation quoted from Schafer, op. cit. note 1, 62. See also Bailey, op. cit. note 6, 57; Menninghaus, op. cit. note 8, 475; Brown et al. (eds), op. cit. note 36, 6, 286. Schopenhauer was also mentioned by James Sully and Theodor Lessing (see below).

39. Schopenhauer, op. cit. note 38, 156 (my translation).
40. Charles Babbage, 'Street Nuisances', in Martin Campbell-Kelly (ed.), *The Works of Charles Babbage*, Volume 11: *Passages from the Life of a Philosopher* (London: William Pickering, 1989), 253–71, at 254. This tract was originally published in 1864 as a pamphlet, titled 'A Chapter on Street Nuisances'.
41. Ibid., 253.
42. Ibid., 259. For Babbage's campaign, see also Bailey, op. cit. note 6, 61; Sully, op. cit. note 37, 718; Schafer, op. cit. note 1, 66.
43. Michael Haberlandt, 'Vom Lärm', in *Cultur im Alltag: Gesammelte Aufsätze von Michael Haberlandt* (Wien: Wiener Verlag, 1900), 177–83, at 177–78.
44. Sully, op. cit. note 37, 704. For other observations concerning the discussion of (street) noise in terms of civilization and barbarism, see Bailey, op. cit. note 6, 60–61.
45. Quotations from Sully, op. cit. note 37, (in order) 706, 720, 707 and 709.
46. Theodor Lessing, *Der Lärm: Eine Kampschrift gegen die Geräusche unseres Lebens* (Wiesbaden: Verlag von J.F. Bergmann, 1908), 45 (my translation). For Lessing's ideas, see also: T. Lessing, 'Die Lärmschutzbewegung', *Dokumente des Fortschritts*, Vol. 1 (October 1908), 954–61; Lessing, 'Ueber Psychologie des Lärms', *Zeitschrift für Psychotherapie und medizinische Psychologie*, Vol. 1 (1909), 77–87.
47. Lessing, *Der Lärm*, op. cit. note 46, at 11 and 20 (my translations).
48. Dan McKenzie, *The City of Din: A Tirade Against Noise* (London: Adlard & Son, Bartholomew Press, 1916), v.
49. Quotations from Stanley Rowland, 'Noise', *The Nineteenth Century and After*, Vol. XCIV, No. 559 (September 1923), 313–23, at (in order) 315, 317, 318, 319 and 314.
50. Ibid., 313.
51. McKenzie, op. cit. note 48, 52.
52. Richard Birkefeld and Martina Jung, *Die Stadt, der Lärm und das Licht: Die Veränderung des öffentlichen Raumes durch Motorisierung und Elektrifizierung* (Seelze [Velber]: Kallmeyer, 1994), 45.
53. Ibid., 39.
54. Ibid., 48. For a discussion of the putative 'age of increasing nervousness', see also Klaus Saul, ' "Kein Zeitalter seit Erschaffung der Welt hat so viel und so ungeheuerlichen Lärm gemacht. . ." – Lärmquellen, Lärmbekämpfung und Antilärmbewegung im Deutschen Kaiserreich', in Günter Bayerl, Norman Fuchsloch und Torsten Meyer (eds), *Unweltgeschichte – Methoden, Themen, Potentiale* (Münster: Waxmann, 1996), 187–217, at 203.
55. McKenzie, op. cit. note 48, 32 and 105.
56. Ibid., 33.
57. Ibid., 69.
58. Haberlandt, op. cit. note 43, 178; McKenzie, op. cit. note 48, 1 and 25–28.
59. Lessing, *Der Lärm*, op. cit. note 46, 15.
60. McKenzie, op. cit. note 48, 28.
61. Haberlandt, op. cit. note 43, 182.
62. Rowland, op. cit. note 49, 316.
63. McKenzie, op. cit. note 48, 111.
64. Birkefeld & Jung, op. cit. note 52, 48.
65. Schafer, op. cit. note 1, 190. For an interesting review of European law concerning the breach of the peace (the noise of neighbours), see Willem Jacobus van Dam, *Burengerucht* ('s Hertogenbosch: W.C. van Heusden, 1888).
66. Lessing, *Der Lärm*, op. cit. note 46, 73–91 (my translation). Difficulties in sentencing the noise of machines applied to several other countries too, but Lessing did not go far into foreign law. In Holland, for instance, industries could be refused permission to set up somewhere, on account of the late 19th-century 'Nuisance Act' (*Hinderwet*). However, refusal was only possible in case of 'severe nuisance', since every kind of industry made noise, and industries could not completely be banned from town areas. Only churches, schools and hospitals were considered to need some protection: C.W. van Ommeren and W.J. Hoendervanger, *De hinderwet en hare toepassing* (Arnhem:

G.W. van der Wiel, 1914), 114–16. The Dutch 'Nuisance Act' came into effect in 1875.

67. Willy Hellpach, *Nervösität und Kultur* (Berlin: Verlag von Johannes Räde, 1902), 32 (my translation).
68. Ibid., 38 (my translation and italics).
69. See Lessing, *Der Lärm*, op. cit. note 46, (in order) 46, 62, 51–53. See also Matthias Lenz, ' "Ruhe ist die erste Bürgerpflicht": Lärm, Großstadt und Nervösität im Spiegel Theodor Lessings "Antilärmverein"', *Medizin, Gesellschaft und Geschichte*, Vol. 13 (1994), 81–105.
70. Corbin (1999), op. cit. note 12, 302–05.
71. Adaptation of the pavement (sidewalk) had been preceded in England by the use of straw outside hospitals, in Paris by gritting peat in front of the dwellings of honourable persons, and in Holland by sprinkling sand in front of the homes of the sick. See: Bailey, op. cit. note 6, 59; *Algemeene inlichtingen over de lawaai-bestrijding* (Delft: Geluidstichting, 1936), 3; *Verslag van het 'Anti-Lawaai Congres', georganiseerd te Delft, op 8 november 1934 door de Koninklijke Nederlandsche Automobiel Club in samenwerking met de Geluidstichting* (Delft: KNAC/Geluidstichting, 1934), 21. For a general discussion of changes in street pavements (sidewalks), see Clay McShane, 'Transforming the Use of Urban Space: A Look at the Revolution in Street Pavements, 1880–1924', *Journal of Urban History*, Vol. 5, No. 3 (May 1979), 279–307.
72. G. Pinkenburg, *Der Lärm in den Städten und seine Verhinderung* (Jena: Verlag von Gustav Fischer, 1903).
73. Lentz, op. cit. note 69, 85. See also: Frederik Hogewind, *Analyse en meting van het dagrumoer* (Utrecht: L.E. Bosch & Zoon, 1926), 11; Lawrence Baron, 'Noise and Degeneration: Theodor Lessing's Crusade for Quiet', *Journal of Contemporary History*, Vol. 17 (1982), 165–78, at 169–70; Rainer Marwedel, *Theodor Lessing: 1872–1933* (Darmstadt & Neuwied: Hermann Luchterhand Verlag, 1987), 104–07. The full title of the German journal was: *Der Anti-Rüpel: Antirowdy: Das Recht auf Stille, Monatsblätter zum Kampf gegen Lärm, Roheit und Unkultur im deutschen Wirtschafts-, Handels- und Verkehrsleben*. From the second issue onwards, its main title was *Das Recht auf Stille*. In *Der Lärm* (op. cit. note 46, at 43), Lessing also mentioned the existence of a 'Society for the Protection from Street Noise' (*Verein zum Schutz gegen den Strassenlärm*) in Nürnberg. However, no additional references to the latter society are known to me.
74. A.H. Davis, *Noise* (London: Watts, 1937), 132; O.M.T. Meyer and H.P. Potman, *Voor de bestrijding van het lawaai: Een onderzoek naar de vorming van het geluidhinderbeleid in Nederland* (Nijmegen: unnamed publisher, 1987), 10–12; A. Dubois, 'Voorwoord van den Voorzitter', *Stilte*, Vol. 1, No. 1 (May 1938), 3; Baron, op. cit. note 73, 169; *Noise Abatement Exhibition* (London: The Anti-Noise League, 1935), 39–43. The latter source mentions 1927 instead of 1928 as the start of the French noise abatement society. In 1909, Lessing ('Über Psychologie des Lärms', op. cit. note 46, 86) also referred to noise abatement societies in Rotterdam and Brussels, but again, no additional references to these societies are known to me.
75. Lord Horder, 'Foreword', *Quiet*, Vol. 1, No. 1 (March 1936), 3.
76. For the successes of Lessing's *Antilärm-Verein*, see Birkefeld & Jung, op. cit. note 52, 51–52.
77. Birkefeld & Jung, op. cit. note 52, 57; Lentz, op. cit. note 69, 93; Saul, op. cit. note 54; Klaus Saul, 'Wider die "Lärmpest": Lärmkritik und Lärmbekämpfung im Deutschen Kaiserreich', in Dittmar Machule, Olaf Mischer und Arnold Sywottek (eds), *Macht Stadt krank? Vom Umgang mit Gesundheit und Krankheit* (Hamburg: Dölling und Galitz Verlag, 1996), 151–92. Before World War I, German noise experts thought that working-class people were so used to industrial noise that city noise did not bother them: see Saul, op. cit. note 54, 203. In the late 1920s and early 1930s, however, organizations such as the 'German Society of Industrial Hygiene' (*Deutsche Gesellschaft für Gewerbehygiene*) and the 'German Society of Mechanical Engineers' (*Verein Deutscher Ingenieure*) started to abate industrial noise. In 1929, the metal sector

acknowledged industrial hearing loss. See Braun, op. cit. note 11; A. de Bruijn, *50 jaar akoestiek in Nederland* (Delft: Nederlands Akoestich Genootschap, 1984), 5.

78. According to Chester Morrow, onr Morrow, onhe 'state of civilization' attained in a specific country by looking at 'theɔoking at 'theits roads', 'the position of women' and 'the minimizing of noise'. The firsɔise'. The firsK in the United States, but 'As to noise we are yet in the depths of degradths of degradhester F. Morrow, 'Anti-noise Legislation now pending in the City Council and under consideration by the Anti-noise Committee', *The Bulletin of the Medical and Chirurgical Faculty of Maryland*, Vol. V, No. 7 (January 1913), 117–21, at 121.
79. See: John Whiteclay Chambers II, *The Tyranny of Change: America in the Progressive Era, 1890–1920* (New York: St Martin's Press, 1992), 292; Martin V. Melosi, 'The Urban Environmental Crisis', in Leon Fink (ed.), *Major Problems in the Gilded Age and the Progressive Era* (Lexington, MA: D.C. Heath, 1993), 423–34, at 430.
80. *Report of The Society for the Suppression of Unnecessary Noise, 1907–1913* (unnamed publisher, no date), at 20 (my page-numbering); Raymond W. Smilor, 'Cacophony at 34th and 6th: The Noise Problem in America, 1900–1930', *American Studies*, Vol. 18, No. 1 (1971), 23–28; R.W. Smilor, 'Toward an Environmental Perspective: The Anti-Noise Campaign, 1893–1932', in Martin V. Melosi (ed.), *Pollution and Reform in American Cities, 1870–1930* (Austin, TX & London: University of Texas Press, 1980), 135–51; Hillel Schwartz, 'Beyond Tone and Decibel: the History of Noise', *The Chronicle of Higher Education*, (9 January 1998), B8.
81. Henry J. Spooner, quoted in 'The World's Plague of Noise', *The Literary Digest* (6 October 1928), 18–19, at 18.
82. Birkefeld & Jung, op. cit. note 52, 40.
83. Robert T. Beyer, *Sounds of Our Times: Two Hundred Years of Acoustics* (New York: Springer-Verlag, 1999), 206. Those who used the older definition followed Helmholz. See: Sully, op. cit. note 37, 704–06; Pinkenburg, op. cit. note 72, 7; Lessing, *Der Lärm*, op. cit. note 46, 37–38; Hogewind, op. cit. note 73, 16–18. For the newer type of definition, see: Charles S. Myers, 'Preface', in F.C. Bartlett (ed.), *The Problem of Noise* (Cambridge: Cambridge University Press, 1934), vii–x, at viii; Davis, op. cit, note 74, 6; A. Dubois, *Lawaai en lawaaibestrijding* (Den Haag: Moorman's Periodieke Pers, 1937), 3. In German and Dutch, one can discern *Gerausch* or *ruis* (noise as the opposite to 'signal') and *Lärm* or *Lawaai* (noise as 'clamour'), whereas the English language only has 'noise'. Of course, a tree can 'rustle', but that again is different from the use of 'noise' as the opposite to signal. It is not possible here to elaborate on the etymology of 'noise' and comparable terms in other languages, but it is interesting to note, as Beyer has done, that technological development influenced the use and meaning of the concept of 'noise'.
84. Dubois, op. cit. note 83, 26.
85. Beyer, op. cit. note 83, 219–22.
86. R.B. Serle, 'The Measurement of Loudness', *Quiet*, Vol. 1, No. 1 (March 1936), 19–21, at 20. In Germany, the unit of the *Phon* was used. The loudness of, for instance, 60 Phon concurred with 60 decibel, thus – by definition – only for a tone of 1000Hz.
87. Rogers H. Galt, 'Results of Noise Surveys, Part I: Noise Out of Doors', *Journal of the Acoustical Society of America*, Vol. 2, No. 1 (July 1930), 30–58.
88. Walter G. Vincenti has described such a process of quantification of subjective notions for the flying qualities of American aircraft, 1918–43. Flying qualities are 'characteristics of an aircraft that govern the ease and precision with which a pilot is able to perform the task of controlling the vehicle', such as the 'forces and movements required by cockpit devices used to move the control surfaces' and 'inherent stability'. Such qualities had formerly been evaluated by pilots in subjective, qualitative terms such as 'responds very readily', 'normal' and 'good'. However, engineers and test-pilots together specified those flying qualities into units – stick force, elevator angle, long and short modes of dynamic stability – that could be measured quantitatively, so that aircraft could be designed to be stable and still manœuvrable. In the process,

pilots had to learn how to specify what they felt, by learning to separate and record the relevant forces. See Walter G. Vincenti, *What Engineers Know and How They Know It: Analytical Studies from Aeronautical History* (Baltimore, MD & London: The Johns Hopkins University Press, 1990), 53–54, 64, 71. In Vincenti's aircraft-case, it was the purpose of both the engineers and the pilots to bring the quantitative and the qualitative as closely together as possible, or to quantify the 'feel' of the pilots as specifically as possible. In the case of noise, the engineers knew that loudness was only one aspect relevant to the subjective notion of annoyance. Research into several of the other aspects that contributed to the annoyance of specific sounds only started later.

89. Shirley W. Wynne, 'New York City's Noise Abatement Commission', *Journal of the Acoustical Society of America*, Vol. 2, No. 1 (July 1930), 12–17, at 13.
90. Brown et al. (eds), op. cit. note 36, v–vii, 3, 57 and 212.
91. Ibid., 17.
92. Ibid., 26.
93. Ibid., 74.
94. Dembe, op. cit. note 10, 201, 210 and 224.
95. Smilor (1971), op. cit. note 80, 35–36; Smilor (1980), op. cit. note 80, 147–48.
96. *City Noise Volume II* (New York: Noise Abatement Commission, 1932), Chapter II, 3–4.
97. For this observation, see also Emily Thompson, 'Listening to/for Modernity: Architectural Acoustics and the Development of Modern Spaces in America', in Peter Galison and Emily Thompson (eds), *The Architecture of Science* (Cambridge, MA: MIT Press, 1999), 253–80, at 266.
98. H.G. Strauss, 'Noise and Some Legal Remedies', *Quiet*, Vol. 1, No. 5 (July 1937), 17–20, at 19. For information about the Road Traffic Act, see also *Noise Abatement Exhibition*, op. cit. note 74, 7–8.
99. *Noise Abatement Exhibition*, op. cit. note 74, Foreword.
100. Ibid., 79.
101. Brown et al. (eds), op. cit. note 36, 10.
102. 'Promoting Quiet Abroad', *Quiet*, Vol. 1, No. 6 (October 1937), 30–33, at 31.
103. 'Breda bindt den strijd tegen het stadslawaai aan', *De Telegraaf* (30 March 1935); 'Meer stilte: "Anti lawaai"-week in Den Haag', *Nieuwe Rotterdamsche Courant* (19 September 1935); *Algemeene inlichtingen over de lawaai-bestrijding*, op. cit. note 71, 5; *Verslag van het 'Anti-Lawaai Congres'*, op. cit. note 71, 33; *Verslag van het Tweede Anti-Lawaai-Congres te Delft op 21 april 1936 georganiseerd door de Koninklijke Nederlandsche Automobiel Club en de Geluidstichting* (Delft: Geluidstichting, 1936), 59–78.
104. *City Noise Volume II*, op. cit. note 96, Chapter 8, 18.
105. Y.Y., 'Less Noise, Please', *The New Statesman and Nation* (31 August 1935), 274–75, at 274.
106. See Birkefeld & Jung, op. cit. note 52; Bijsterveld, op. cit. note 3; also F.A. Geilszler, 'Die Musik des Lärms', *Der Antirüpel*, No. 3 (March 1910), quoted in Hogewind, op. cit. note 73, 15. Likewise, Werner Sombart pointed out such changes in music: see Friedrich Lenger, *Werner Sombart, 1863–1941: Eine Biographie* (München: Verlag C.H. Beck, 1994), 163.
107. Anthony McElligott, 'Walter Ruttmann's *Berlin: Symphony of a City*: Traffic-Mindedness and the City in Interwar Germany', in Malcolm Gee, Tim Kirk and Jill Steward (eds), *The City in Central Europe: Culture and Society from 1800 to the Present* (Aldershot, Hants.: Ashgate Publishing, 1999), 209–38, at 210.
108. 'Stichting voor Materiaalonderzoek, Commissie voor de bestudeering van de acoustische eigenschappen van bouwmaterialen', Document No. 5 (1933), Archives Sound Foundation (*Geluidstichting*) (1933–1942) [abbreviated below as *Archives GS*, and housed at the Dutch Acoustical Society (*Nederlands Akoestisch Genootschap*), Delft, The Netherlands].
109. In the second half of his career, Adriaan Fokker ventured into music, and composed for a self-designed 31-tone organ: De Bruijn, op. cit. note 77, 8; Rudolf Rasch (ed.),

Corpus Microtonale: Adriaan Daniël Fokker (1887–1972), Selected Musical Compositions (1948–1972) (Utrecht: The Diapason Press, 1987).

110. *Archives GS*: 'Stichtingsacte Geluidstichting', 'Notulen van de vergadering, gehouden op 30 Juli 1934 ... ter voorbereiding van de oprichting van een "Geluidstichting" ', 'Toelichting bij het in het leven roepen van een "Geluidstichting" ', letter from G.L. Tegelberg to A.D. Fokker (29 October 1934), *Jaarverslag 1935 der Geluidstichting*. See also De Bruijn, op. cit. note 77, 7, and C. Zwikker, 'De Geluidstichting', *In de Driehoek: Bijdragen op het gebied van de Volkshuisvesting in Nederland*, Vol. 3, No. 6 (November/December 1938), 248–53. Thirty-four institutions participated in the Foundation's Commission of Help, representing local and national government, as well as organizations concerning motorcars, tourism, transport, architecture, housing, contracting, engineering, medicine, housewives, broadcasting, aircraft, cinema, hotels and catering, industry, the 'Nuisance Act Society' (*Hinderwetvereeniging*) and even churches. It may be that the interest of engineers in such a foundation was partly roused by the perspective of a new field of activities, scarce in time of crisis and unemployment. In the same years, comparable foundations, such as the 'Heat Foundation' (*Warmte-Stichting*) were raised in order to create a new labour market. (Personal interview with Ernst Homburg, Maastricht, 16 January 2001.)
111. *Archives GS*: 'Statuten van den Nederlandschen Bond ter Bestryding van Geluidshinder in Nederland', *Jaarverslag van de Geluidstichting over 1937*, 2; [W.L.G.] Jas, 'De oprichting van den Anti-Lawaaibond en een overzicht van het eerste werkjaar', *Stilte*, Vol. 1, No. 1 (May 1938), 4–9; [W.L.G.] Jas, 'Overzicht van hetgeen reeds op het gebied der geluidsbestrijding in Nederland werd verricht', ibid., 10–14. The official name of the Anti-Noise League was 'Dutch League for Noise Abatement' (*Nederlandsche Bond ter Bestrijding van Geluidshinder*). Local committees existed in, for instance, Amsterdam and Groningen.
112. *Verslag van het 'Anti-Lawaai Congres'*, op. cit. note 71; *Verslag van het Tweede Anti-Lawaai-Congres*, op. cit. note 103. For earlier noise concerns of the Royal Automobile Club, see *Archives GS*: 'Notulen van de vergadering, gehouden op 30 Juli 1934 ... ter voorbereiding van de oprichting van een "Geluidstichting" ', letter from A.D. Fokker to C. Zwikker (21 September 1934), Minutes Board of Directors Sound Foundation (17 April 1935).
113. *Verslag van het 'Anti-Lawaai Congres'*, op. cit. note 71, 16 (my translation).
114. *Verslag van het Tweede Anti-Lawaai-Congres*, op. cit. note 103, 17 (my translation).
115. *Verslag van het 'Anti-Lawaai Congres'*, op. cit. note 71, 77.
116. *Archives GS*: Pamphlet 'Anti-Lawaai Comité Groningen' (1936) (my translation); 'Anti-lawaai-week 23–28 September 1935', *Algemeene inlichtingen over de lawaai-bestrijding*, op. cit. note 71; 'De anti-lawaaimaand te Breda', unidentified newspaper (probably *Dagblad van Noord-Brabant*) (2 March 1935); 'Meer Stilte: Anti-lawaai-week in de residentie', *De Nieuwsbron* (19 September 1935); letter from Walter Matthies to the Office of the Sound Foundation (5 October 1935); letter from 'Bond van Bedrijfsautohouders in Nederland' to Office of the Sound Foundation (5 February 1936). Although issues such as the proper loading of trucks, and refraining from playing musical instruments or radios at night, were also covered, the control of traffic noise clearly had priority.
117. 'Promoting Quiet Abroad', op. cit. note 102, 32.
118. *Archives GS*: letter from A.D. Fokker to G.L. Tegelberg (27 October 1934); letter from A.D. Fokker to C. Zwikker (28 December 1934).
119. *Verslag van het Tweede Anti-Lawaai-Congres*, op. cit. note 103, 24 and 30 (my translation).
120. Myers, op. cit. note 83, x; McElligott, op. cit. note 107, 222.
121. 'Breda, de Anti-Lawaai-Stad: Een onderhoud met Dr H.J.L. Struijcken', *Dagblad van Noord-Brabant* (April 1935); 'Verkeerszondaars de oorzaak van straatlawaai: De automobilisten tot toeteren gedwongen', *De Telegraaf* (19 September 1935).
122. *Verslag van het Tweede Anti-Lawaai-Congres*, op. cit. note 103, 26.
123. Dembe, op. cit. note 10, 172.

124. McElligott, op. cit. note 107, 223.
125. Thomas P. Hughes, *American Genesis: A Century of Invention and Technological Enthusiasm 1870–1970* (New York: Penguin Books, 1989), 4.
126. *Archives GS*: 'Richtlijnen van den Raad van Bestuur der Geluidstichting nopens plaatselijke bestrijding van geluidshinder', *Annual Reports of the Sound Foundation* (1936, 1937, 1938, 1940).
127. Smilor (1971), op. cit. note 80.

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