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London Street Noises: A Ground-Breaking Field Recording Campaign from 1928

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Abstract: In a leading article by Sir Percival Philips in the UK popular newspaper, the Daily Mail, 16 July 1928, came the following headlines: "Millions Lost by Noise–Cities' Worst Plague–Menace to Nerves and Health–What is Being Done to Stop it". The article was supported by research from Prof Henry J. Spooner, who had been researching and campaigning on the ill-effects of noise and its economic impact. The article sparked subsequent discussion and follow-up articles in the Daily Mail and its international partners. In an era of rapid technological change, that was on the cusp of implementing sound pressure measurements, the Daily Mail, in collaboration with the Columbia Graphophone Company Ltd, experimented with sound recording technology and commentary in the field to help communicate perceived loudness and identify the sources of "unnecessary noise". This resulted in the making of series of environmental sound recordings from five locations across central London during September 1928, the findings of which were documented and discussed in the Daily Mail at the time, and two recordings commercially released by Columbia on shellac gramophone disc. This was probably the first concerted anti-noise campaign of this type and scale, requiring huge technological efforts. The regulatory bodies and politicians of the time reviewed and improved the policies around urban noise shortly after the presentation of the recordings, which were also broadcast from the BBC both nationally and internationally, and many members of the public congratulated and thanked the Daily Mail for such an initiative. Despite its unpreceded scale and impact, and the recent scholarly attention on the history of anti-noise campaigning, this paper charts and contextualises the Daily Mail's *London Street Noise* campaign for the first time. As well as historical research, this data has also been used to start a longitudinal comparative study still underway, returning to make field recordings on the site on the 80th and 90th anniversaries and during the COVID-19 lockdown, and shared on the website londonstreetnoises.co.uk.

Keywords: field recording; noise abatement; soundscape; anti-noise campaigns

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1. Introduction

This paper provides a historical narrative and analysis of *London Street Noises* (LSN): an anti-noise campaign carried out in September 1928 by the popular UK newspaper, the Daily Mail. In collaboration with the Columbia Graphophone Company Ltd, they experimented with sound recording technology and commentary in the field to help communicate perceived loudness and identify the sources of "unnecessary noise". This was a time of rapid technological development, for example, it is the same month of the European premiere of The Jazz Singer, the first full-length film with synchronised dialogue and music, in Piccadilly Theatre, London (27th September 1928), using the Vitaphone sound-on-disc technology. Acoustics and noise control was an emerging field, and was on the cusp of implementing sound pressure measurements [1]. LSN was prompted by a leading article by Sir Percival Philips (respected WW1 correspondent) in the Daily Mail, 16 July 1928, which came with the following headlines: "Millions Lost by Noise–Cities' Worst Plague–Menace to Nerves and Health–What is Being Done to Stop it" [2]. The article was supported

by research from Henry J. Spooner, who had been researching and campaigning on the ill-effects of noise and its economic impact. The article sparked subsequent discussion and follow-up articles in the Daily Mail and its international partners.

This research trajectory by the Soundscape SIG at Goldsmiths' Unit for Sound Practice Research, commenced with an interest in the history of field recording and with one artefact, Figure 1: a twelve-inch disc, two-sided shellac gramophone disc published by Columbia, numbered 9413. It is titled *London Street Noises*, with recordings of urban sounds from Leicester Square on one side, and Beauchamp Place on the other. The duration of each side is approximately 5 min. On the label it states: "Made in conjunction with the Daily Mail" with "Explanations by Commander Daniel". The recordings provide us with an urban soundscape of those environments through the sound recording technology of the day. The voice of Commander Daniel, who focuses exclusively on traffic, provides opinions on the quality of the soundscape as it unfolds. At the start of each recording, he announces the time, date and location of the recordings.

Figure 1. Published Columbia Records London Street Noises (LSN) disc label.

Commander Daniel was somewhat of a hero for the Daly Mail readership of the day. The LSN recordings quickly follows his departure from the Royal Navy, due to his involvement in the Royal Oak Affair, a cause célèbre of the day. The Daily Mail had supported him throughout the court martial and had committed to hiring him as a correspondent following his dismal [3].

Field recording has been central to soundscape studies from its inception: pedagogic creative listening experiments, interpretative artistic compositions, sound archive, material for study in the laboratory. All these approaches can be heard in Soundscapes of Canada (1974): 10 one-hour radio programs based on the sounds of Canadian acoustic environment (World Soundscape Project (WSP), directed by Schafer, 1974). Of course, the WSP was enabled by mobile sound recording kit, the WSP following WW2, first exploited by New York radio producer Tony Schwartz:

'Once I was free of Mr. Edison's cables, I could explore the beauty of language in everyday situations and the sounds of life around us.' [4,5].

This intriguing disc also finds itself grouped among sound effects records released by Columbia. From the late 1920s and onwards, Columbia was marketing "sound effects" recordings, which were produced for use in theatre and radio at the time [6]. This was very much a developmental stage for the use and codification of recorded sound effects. Although we find location recordings at this time, producers were learning that field recordings from specific locations often failed as a successful sound effect: "highly efficient, unambiguous / stereotypical, sonic shorthand representing or evoking an activity, an event, an environment or location and its desired mood, and like a meme is extremely promiscuous, and has a high propensity for deterritorialization." [7]. Soundscape recordings don't necessarily fulfil that classification, but do provide an actual inscription of the time and place of where a recording is made. The LSN record among sound effects records such as the human vocalisation of farmyard sounds immediately stands out as a different category.

As a process of historical re-enactment and a rare opportunity for extensive longitudinal soundscape recording comparison, on the occasion of the 80th anniversary (2008) of the recordings at exactly the same time of day, John Drever was prompted to return to Beauchamp Place. On the run up to the 90th anniversary (2018), when the days of the week coincided with 1928, some further research was carried out, and thanks to an article by Peter Copeland in *Playback* no. 13 (1996), the bulletin of the British Library National Sound Archive, more LSN recordings hosted by the Museum of London were discovered. To allow the digitisation of the discs at the Goldsmiths' Electronic Music Studios (under the supervision of Ian Stonehouse) for the Museum of London's digital archive, a box of 14 separate recordings, which were originally donated to the Museum of London by the editor of the Daily Mail at the time, was delivered. The discs featured more recordings from the above locations with the addition of other locations: the junction of Whitechapel/Commercial Street/Aldgate, St George's Hospital (which was located at Grosvenor Place) and Cromwell Road (west of Queens Gate), all recorded in September 1928.

In Figures 2 and 3, the Cromwell Road record and a close view of its label reveal some comments put at the time on the type of sounds audible in the recording and its quality.

Working through issues of the Daily Mail at the time, it was evident that this was a major campaign, with the project featuring in multiple articles and features, including photos of the apparatus and of the actual location including the positioning of some of the microphones in situ, like for the 1928 position in Beauchamp Place 15, visible in Figure 4 where the black arrow is pointing to [8], and for which a modern picture is also shown in Figure 5.

This was probably the first concerted anti-noise campaign of this type and scale, requiring huge technological efforts. This adoption of field recording predates the reliable yet reductive ascendency of metrics that sound pressure measurement and the adoption of the decibel SPL, would allow—in 1926 E. E. Free was pioneering this use of an audiometer to make a "noise map" of Manhattan [9].

Figure 2. Cromwell Road LSN record.

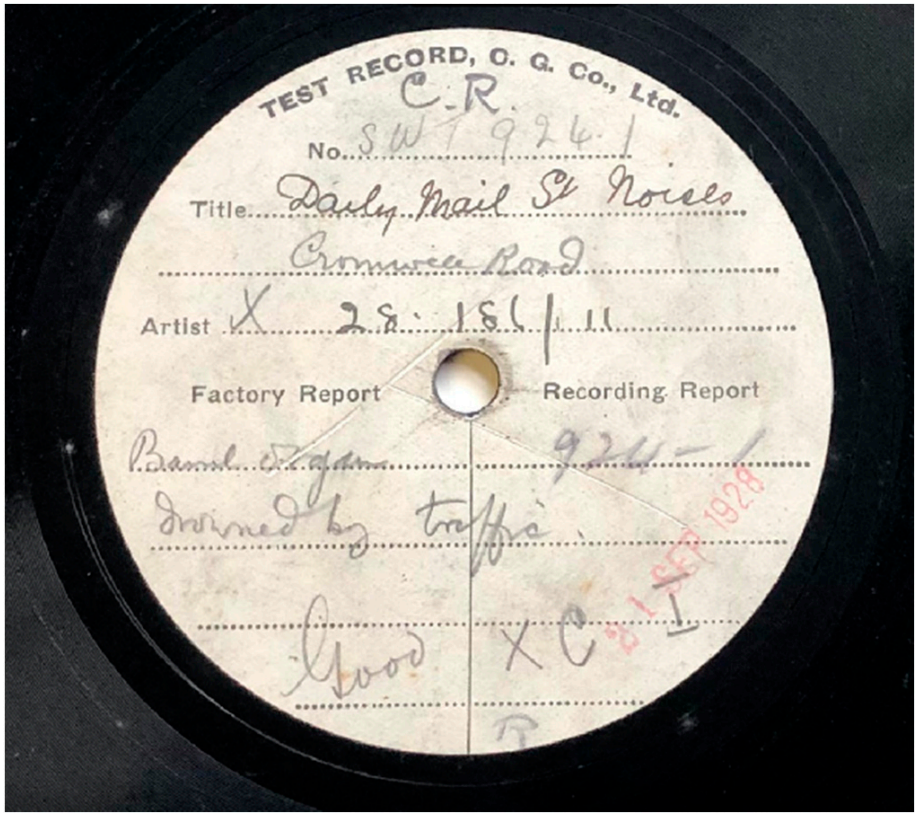

Figure 3. Cromwell Road LSN record label.

Mrs. Helen Riou's shop in Beauchamp-place, off Brompton-road, where records of noises were taken. The arrow indicates the microphone.

Figure 4. Beauchamp Place—microphone location in 1928.

Figure 5. Beauchamp Place—nowadays.

The regulatory bodies and politicians of the time reviewed and improved the policies around urban noise shortly after the presentation of the recordings, which were also broadcast from the BBC both nationally and internationally, and many members of the public congratulated and thanked the Daily Mail for such an initiative. Despite its unpreceded scale and impact, and the recent scholarly attention on the history of anti-noise campaigning [4,10–13], this paper charts and contextualises the *London Street Noise* campaign for the first time.

2. History of Noise Abatement Campaigns

In order to situate the 1928 Daily Mail initiative within the history of campaigns against noise, it's important first to sketch out the similar movements and activities around the

issue of noise around that time. After looking at the main discourses and understandings of the period, it will be possible to make connections to the wider conditions which enabled the production of such campaigns. Following Bijsterveld's periodisation of noise abatement campaigns [14], the Daily Mail project would fit in the second wave of the activism which peaked around the first half of the 1930s and was characterised by increased complaints against industrial noise. What preceded this wave, however, was noise as a problem that ostensibly affected the upper-classes and intellectuals. This kind of noise, in Europe, from the end of the nineteenth century until the beginning of the 1900s, was in the form of a nuisance which is caused mainly by street musicians and other human-made sources [14–17]. This sort of disturbance manifests through the comments and campaigns of writers such as Charles Babbage, Charles Dickens, Thomas Carlyle and Thomas Moore who lived in London [15] at that time as well as from those of Schopenhauer and Theodor Lessing from Germany [14]. These writers found street noises insufferable and posing a serious risk specifically for 'brain-workers' since focusing on intellectual work was made impossible as the din was thought to affect, more than anything else, the nerves [12]. Following the complaints and the individual campaigns of the intellectuals, in the UK, the Metropolitan Police Act 1839 was issued to regulate this kind of street nuisances [16].

Beyond individual complaints, at the beginning of the twentieth century, the first examples of organised campaigns throughout the West start to appear as the first wave of noise activism: the establishment of the 'New York's Society for the Suppression of Unnecessary Noise' in 1906, the 'London Street Noise Abatement Committee' in 1908 and the 'German Association for Protection from Noise' in 1909. Whereas the New York society had an influence on the legislation [13] and the German Association was successful in making an impact, the London Committee did not manage to affect policies [18]. One important point that should be highlighted here is that the representation of the noise nuisance in this period was mainly through the individual upper-class campaigners and the effects of noise was therefore discussed with reference to increased irritability and sensitivity of the intellectuals who are in desperate need of quietness [15]. Therefore, the noise experience of the poor, how they are affected, remains unclear. However, as demonstrated shortly, what motivated the Daily Mail campaign went well beyond the effects of noise on the brain-work.

According to Bijsterveld [10], from the last quarter of the 1900s, the noise of machinery (trains, automobiles, tramway cars, lorries, etc.) has become the main focus of complaints. This is indeed when the Daily Mail project was carried out as part of the second wave movements: by 1928, the streets of London were already invaded by all sorts of loud and noisy transportation vehicles: lorries, motor bikes, motor cars, tramway cars and motor omnibuses in addition to buskers and horse-drawn carriages. Another aspect that matches the newspaper's activities with the second wave campaigns is that although it did not lead to a 'mass movement' [14] of anti-noise activism, the media coverage was as notable as those that came out during the 1930s. The main source of activities for this kind of publications during this period, on the other hand, would originate from the more organised campaigns such as the 'Anti-Noise League' within the UK which was established in the 1933 followed by the Anti-Noise Leagues of Austria and the Netherlands a few years later. Just before the 1930s, France already had a 'Society for the Suppression of Noise' in 1928 and the first surveys on noise were carried out at the end of 1920s in London, Chicago and New York, using audiometers and acoustimeters [14].

In terms of the effect on the legislation, the campaign of the Anti-Noise League in the UK was successful and influenced the Road Traffic Act amendment in 1934 '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 11.30pm and 7am in built-up areas' [14]. As seen later, the Daily Mail campaign also led to the Motor-Cars (Excessive Noise) Regulations in 1929.

Noise abatement campaigns of this period, including the Daily Mail and the Anti-Noise League that followed, were predominantly under the influence of what has been described as the 'neurasthenia' discourse [12]. The main argument of the members of the Anti-Noise League was based on the negative effect of noise on nerves: an assemblage of symptoms such as fatigue, anxiety, headache, irritability to the stimulants, rather than a specific condition. Although it is virtually an obsolete term today, neurasthenia, as a frequent diagnosis, also remained prominent to describe noise effects on health from the mid-1800s until 1930s. The Daily Mail campaign, in line with the character of the second wave activities, can be seen as an early step in the construction of noise as a public health problem [10] which is primarily based on the neurasthenia discourse [12]. Just before the start of the campaign, it's worth noting, for example, that the journalist Sir Percival Philipps [2], who inspired the anti-noise campaign idea for the Daily Mail in the first place, refers to noise as a 'plague' and recounts that it leads to 'sleeplessness, excessive irritability, steady depreciation of reserve strength and eventually to complete collapse.' The city din even causes 'drunkenness'. Other content related to noise months before the campaign includes, in addition to health references, a call for legislation and letters from the public which complains about traffic noise near London hospitals [19–22].

Bijsterveld [10] suggested that how noise became a public problem can be analysed through the framework which Gusfield [23] developed in his study of how drinking as a public issue had arisen. In summary, in order for something to become a public problem, both a 'cognitive belief in alterability and a moral judgement of its character' is necessary. What is observed in the Daily Mail campaign as characteristic to the noise issue of the day was indeed the belief that the noisy situations can be prevented and therefore changed through legislation and increased individual responsibility. The morality of the issue, on the other hand, can be seen within the language which is used to describe the ignorance of the officials on the issue as 'illogical legislators' [19] and the drivers of the noisy vehicles as 'thoughtless' or 'selfish'. Making noise is an amoral offence where the drivers of noisy motor cars or motor bikes are perpetrators and the legislators are failing to control this issue. Narratives of noise as a harm-inflicting event on nerves which supported the construction of noise as public problem had been frequently published well before the campaign until the aftermath and the establishment of the Anti-Noise League.

3. History of the Daily Mail Initiative

As learnt from the papers of the time, the Daily Mail's project which includes the arduous job of recording the "noises" of London streets was precipitated by some important events. First, the resignation of Commander Daniel, who will be a central figure in the initiation and the implementation of the project, from the Navy and his recruitment by the Daily Mail in April 1928 [20]. Second, Philipps' abovementioned article, titled 'Millions Lost by Noise: Cities' worst plague' [2] and published in July that year, seemed to have received abundant support from the members of the public. He did not only highlight noise as a menace to health as well as to the economy, but also called for an anti-noise campaign based on the similar examples of activism of that day such as the establishment of a Noise Abatement League in Melbourne. He argued that such a campaign in the UK 'would receive strong support from the jaded victims of noise' as well. The next day, Lord Montagu of Beaulieu, 'a motoring and transport authority', is reported to have expressed his support for Philipps' article, blaming the legislators for not controlling the 'hideous noises', such as the sound of motor vehicles, 'clatter of lorries', or the mechanical horn [19]. Within the following few months, the newspaper articles mention support letters from the members of the public on noise which were sent to the 'People's League for Health' after Philipps' article [21]. The British Medical Association also called for a local action for noise abatement whereas the newspaper also featured newly issued noise legislations from around Europe as well as more support letters from the public sent to the Daily Mail [22]. The concerns around the noise that surrounds London Hospital hit the titles at the beginning of September: 'Tortured by Noise: Hospital patient and the thoughtless

motorist' [24]. The depiction of the vulnerable patients is indeed prominent within the public health discourse throughout the project. This was shortly after the Home Secretary of the time, Sir William Joynson-Hicks told the newspaper that he was 'consulting with Ministers of Transport and Health' [22].

Commander Daniel and his team's soon-to-be-successful initiative to take the recordings at five central London locations (see map in Figure 6 and Table 1 with the exact dates and locations) in order to demonstrate the 'insufferable din' that affects many city dwellers started to take place immediately after the publication of these letters. The preparation was already completed on the 5th of September 1928 [25]. With the collaboration of the Columbia Graphophone Company and the support of some local authorities as well as expert and non-expert members of the public, the team set up the recording equipment, which took the space of an entire room, at the first location. The next day, the team recorded the sounds of the East End through the recording device that was set up in 1 Leman Street, on Gardiner's Corner, which is now Aldgate East Station, at the intersection of Commercial Street and Whitechapel High Street. The recording equipment itself was set up in a room within a hairdresser and the microphone was suspended outside the window on the first floor of a trunk store. Commander Daniel reports that 'Outside in the street the traffic was at its heaviest; a constant stream of tramway-cars, lorries, motor-omnibuses, and horse-drawn drays and lighter vehicles passed east and west and south and north.' [26] He described Whitechapel's road traffic as a roar: there were waves of motor vehicles, accelerating and racing.

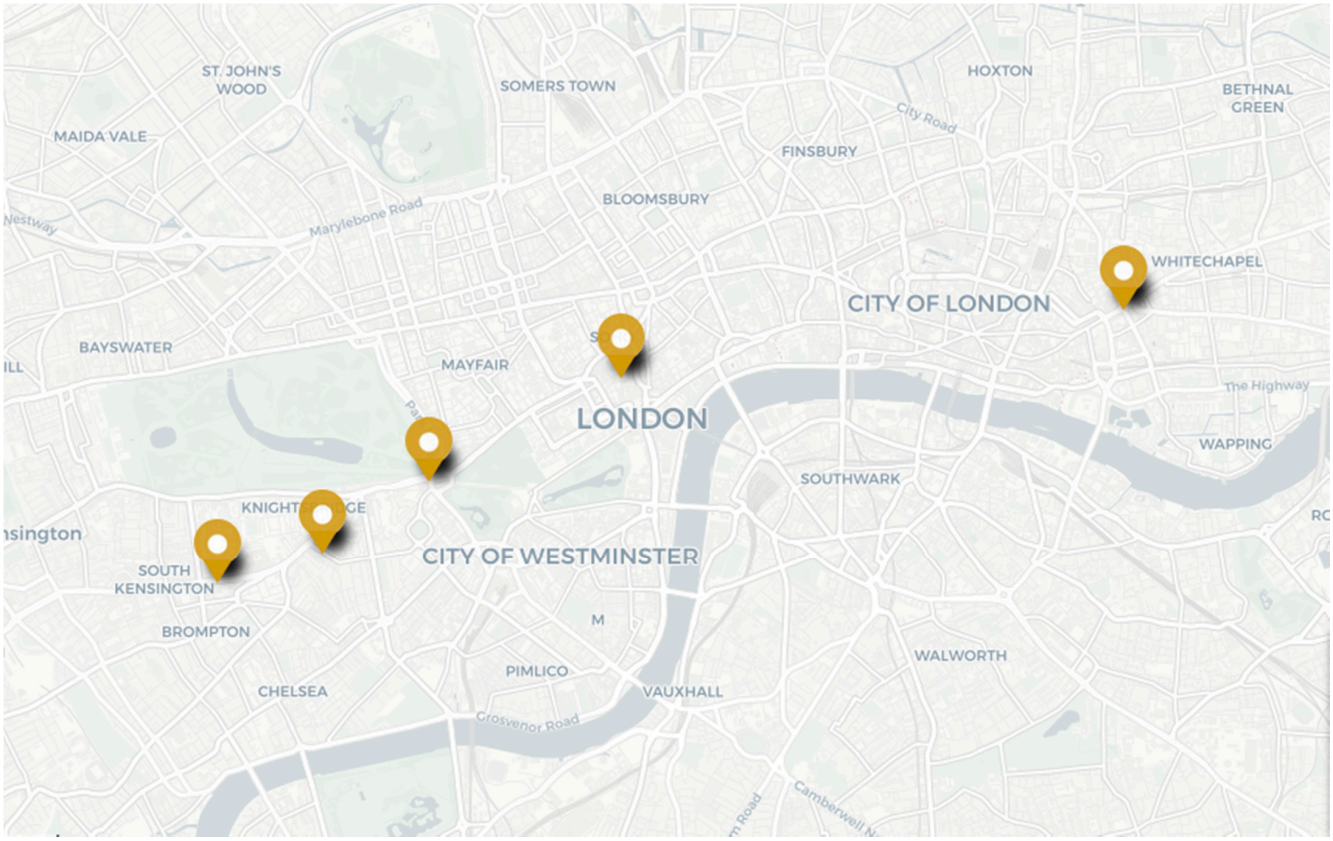

Figure 6. Map of the LSN recording locations.

Table 1. LSN Recordings locations and dates.

Location	Dates	Time			
Junction of Whitechapel/Commercial Street/Aldgate	4th September 1928 (Tuesday)	12:00	-	-	-
St George's Hospital/Grosvenor Place	7th September 1928 (Friday)	14:00	-	-	-
Leicester Square	11th September 1928 (Tuesday)	14:30	14:45	15:00	-
Cromwell Road (west of Queens Gate)	19th September 1928 (Wednesday)	12:00	12:30	unknown	15:10
Beauchamp Place (Mrs Helen Riou's shop, 15 Beauchamp Place)	20th September 1928 (Thursday)	12:00	13:00	13:30	-

The next location recorded was St George's Hospital at Hyde Park Corner which is now the Lanesborough Hotel since 1980 when the hospital was moved to Wandsworth. This time, the recording machine was placed in one of the patients' wards for women and the microphone was hung from a window on the first storey, overlooking Knightsbridge and Grosvenor Place [27]. The traffic of Grosvenor turned out to be more continuous and faster than that of Aldgate with motor vehicles dominating the road. Another particular difference is that whereas the streets of Grosvenor Place were wood-paved which makes it quieter overall, those of Aldgate were granite which makes the passing of horse-drawn vehicles more noticeable. The traffic nevertheless caused an interminable suffering for the patients. It would start at 6am until 4am the next day, so there was almost no respite. The traffic would be so loud that the patients in adjacent beds would need to lean over if they wished to speak to each other. Elderly patients would often ask for cotton wools or plasticines to block out the noise. According to a letter penned by one of the hospital patients called C. Whitaker-Wilson that was sent to the newspaper after the project was finished, each patient would also have earphones by their beds in order to mask the noise by listening to the Proms concert in August. 'but, to hear the harmonies,' says Whitaker, 'I found it necessary to pull the pillows round my head so not to mistake the motor-horns for Sir Henry Wood's orchestral brass.' [28].

Before moving on to the more residential areas, Leicester Square was chosen as to represent how the West End sounded. According to the commentaries [29], the records have shown that motor-cycles, if not fitted with a proper silencer, can be heard above all other sources of noise. Making this preventable noise, as such, was found 'inexcusable'. In addition to the din of the traffic, referred to as 'a medley' accompanied by excessive motor horns, there is also a reference to a construction work, hammering of steels, coming from an unknown location while the records were being taken, which was also considered quite disturbing. In the meantime, the newspaper mentions that London General Omnibus Company was experimenting with pneumatic tyres in an effort to reduce the noise emanating from the buses [30].

The last two recording locations, Beauchamp Place and Cromwell Road, are more residential and therefore one would expect more quietude. However, Commander Daniel reports that many letters of complaint had been sent to the newspaper regarding the traffic noise disturbance there [8]. What makes the street noises most notable in these locations, however, turned out to be the quality of noise: intermittent rather than continuous. As Commander Daniel confirms, this aspect of a sound environment is more 'destructive of a good night's rest than a continuous drone of traffic.' Beauchamp (pronounced 'Beecham') Place was characterised by being a side-road which used to be much quieter but it is now an 'overflow route to the congested main streets'. This time the microphone was placed only 10 ft above the street, by the entrance of Mrs Helen Riou's children's shop. Commander Daniel tells us about how a busker's music was drowned and how their interview was interrupted by the traffic. Finally, the exact location for the Cromwell Road recordings

was the junction of Queens Gate, and more interestingly, very close to where the Home Secretary lived. Commander Daniel highlights the waves of fast-moving traffic that was captured along with whistling, busking, horse hoofing and honking sounds, which would be helpful for comparison.

The series of recordings were successfully completed by the end of the month. In an after-thought article [31], Commander Daniel clarifies that the recorded locations are not claimed to be 'noisier than others' and argues that much of this noise is preventable. He offers practical solutions such as the use of pneumatic tyres (adding that the Ministry of Transport already encouraged using them), avoiding engine-pinking, addressing the 'screech on tram rails' (by abolishing the tramway cars, which Worchester did at that time), and noise caused by 'mechanical inefficiency'. In conclusion, he draws attention to the necessity of a legislation to deal with these, but on the other hand, he stresses the preventable nature of considerable amount of noise and the importance of public cooperation where all drivers would need to 'pull their pound' in the collaborative effort to resolve this issue.

Just a few days later, the Daily Mail's request from the Home Secretary to cooperate and arrange a demonstration of the recordings was accepted [32]. In the meantime, the first government conference about noise nuisance was held [33] within a few days after the completion of the investigation (27th September) and the possible establishment of a committee on noise, and increasing police duties in order to address the issue, were discussed [34]. At the beginning of the following month a demonstration of the recordings to the Home Secretary, the Minister of Transport (Colonel Wilfred Ashley) and some other officials took place [35]. The recordings were played back to them in the quiet Deputation Room of the Home Office. During the demonstration of the records taken from St George's hospital, the Home Secretary asked several times whether the records were 'amplified to exaggerate the noises' [36] and one of the officials was horrified to hear what patients had to suffer. On the other hand, the Home Secretary, listening very carefully to the recordings taken nearby his house, clamoured: 'But where are hoots of the horns? This is nothing to what I have endure.' He added: 'That's more like it,' as he heard some loud motor-horns. The article is indeed titled 'What I have to endure'. The decision to draft regulations on the noise nuisances as such were immediately made after the demonstration [37,38].

The recordings were not only used as an illustration of street din to the ministers. The 'roar of London' was broadcast from the BBC both nationally and internationally (accompanied by Commander Daniel's presentation) [39,40] and reproduced in a Health Exhibition in Kensington Town Hall, opened by Princess Louise Duchess of Argyll who commented on the sounds of heavy lorries in St George's Hospital area recordings as 'Ah, that's what I have to put up with at night.' [41]. The newspaper was congratulated with letters from many members of the public. Starting from October until the end of December, the newspaper continued reporting regularly on the events where noise-making was fined within the UK and on examples of how noise is dealt with in other parts of Europe [42–47]. The consecutive discussions and conferences that were part of the Home Secretary and the Minister of Transport's decisions to draft a regulation after the investigation led to concrete results in 1929 [48], when the Motor-Cars (Excessive Noise) Regulations were issued, which indeed endowed more powers to the police in order to intervene when they deem noise is preventable such as unnecessary hooting. However, this regulation was going to be complemented with more substantial legislation, the amendment of the 1934 Road Traffic Act, which was issued as a result of the activities of the Anti-Noise League which was to be established five years from the Daily Mail campaign. Nevertheless, this brilliant example of investigative journalism and the sound recordings as a valuable outcome for acoustics history remain a crucial event not least because they fill out an important gap in our existing historical knowledge regarding the in-between period of the first and second waves of noise activism in the UK, but also as a contribution into the evolving issue of noise as a public health problem, opening the doors for future historical analyses.

4. Why Field Recording Instead of SPL Metering?

One may wonder why the Daily Mail went through the effort of producing field recordings instead of conducting quantitative measurements of sound pressure levels. The reason is twofold. First, noise level meters were not yet widespread and were still using a multiplicity of different equipment and techniques far from being standardized and comparable with each other. Second, it was already recognized that quantitative analysis alone was not enough to predict the perceived noise annoyance.

In one of the most important review studies of the time on outdoor noise surveys, Galt describes two types of measurement systems used for sound amplitude assessment [49]. One required a trained human operator to subjectively compare the sound under test with a reference tone or reference noise, and varying the amplitude of the latter until masking occurs, effectively borrowing the audiometers available at the time in audiology. A second type didn't need a subjective evaluation and was based on processing the signal from a microphone.

'A different type of observation, employed in recent surveys, is independent of the observer's ear and yields a purely physical measurement. The apparatus consists of a pick-up device, or microphone; an amplifier, with or without a frequency weighting network; a distortionless attenuator; and a rectifying device with a meter.' [49].

However, removing the operator's ear does not guarantee a representative and repeatable assessment. First, the use of such a type of noise meter is critically described as not being truthful to how humans perceive sound. Second, these noise meters rely on a frequency weighting network and integrating device that are not necessarily the same in devices manufactured by different companies, making comparisons across different measurements campaign dependent on using exactly the same make and model.

'In neither case does the noise meter sum up the components of a complex wave in the same manner as does the ear in producing loudness. Hence, if two successive complex waves differ greatly in composition, the corresponding meter readings will not compare the waves as they are compared by the ear. There is thus a definitely arbitrary element involved in the use of the noise meter employed in any particular survey; another noise meter, having a single frequency characteristic different [. . .], and employing a different integrating device, would in general yield different measurements.' [49].

Even ignoring the difficulty in comparing these surveys, it's clear that the scientific community of the time was already aware of the limitations of their approach in predicting annoyance. In Galt's review, both the use of only a noise level or sensation figure (depending on the study and equipment used), as well as the sole use of quantitative analysis, is questioned and the necessity to assess the noise spectrum and the time dynamic together with the role of human agency, is raised.

'A test was made to determine whether or not any evident correlation exists between the overall noise level of each specific source and the frequency of complaints against the source, as compiled by Mr. Dennis of the Noise Abatement Commission. It can be definitely stated that the level of the noise is not the sole factor which determines its annoyance as measured by the number of complaints. . . . the degree of annoyance seems to depend at least to an equally great extent upon other factors, possibly the component frequencies and the general character, whether steady or intermittent, and whether or not the noise is commonly regarded as quite unnecessary, such as the squeaking of brakes of automobiles, or as relatively necessary, such as police whistles.' [49].

Thus the choice of the Daily Mail to use audio recordings in place of noise level measurements seems very appropriate, providing a more nuanced and faithful representation of the sonic environment, a choice that was indeed very effective in raising awareness in both the public and the regulators.

5. The Recording Process in the Context of 1928 Audio Technology

Technical details about the audio recording system used for the LSN project are scarce in the Daily Mail articles, thus the reconstruction attempted here is based on a more general knowledge of the audio technology of the time.

First, the audio recording technology in 1928 was in the infancy of its "electrical era". This is to distinguish it from the "acoustic era", the first recording technology, purely based on acoustic and mechanical transduction: a horn that amplifies the sound to a level high enough to drive a small engraving stylus connected to a membrane at the throat of the horn. The stylus would engrave a wax or disc cylinder, like in Edison's phonograph Figure 7. (By Norman Bruderhofer, www.cylinder.de-own work (transferred from de:File:Phonograph.jpg), CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=427395 (accessed on 16 February 2021).).

An electrical recording relies instead on a signal chain composed of a microphone, and an audio amplifier and electronic filters which drive an electromechanical actuator to engrave a wax cylinder or disc. The shift to the electrical era was made possible by the invention by Lee De Forest of the triode tube in 1907, which led shortly after to the development of electronic amplifiers. They were first employed to boost the signal strength on telephone lines, but soon there were many companies and independent researchers using this new technology for audio recording. Of the many documented experiments, the most relevant for the London Street Noises project were those in 1924 (Frayne) when Western Electric produced some high-quality test recordings that paved the way for a successful diffusion of their system commercially. This was called the "Westrex", and a picture of its electromagnetic cutter developed by Bell Labs is visible in Figure 8 [50].

Figure 7. Edison's phonograph.

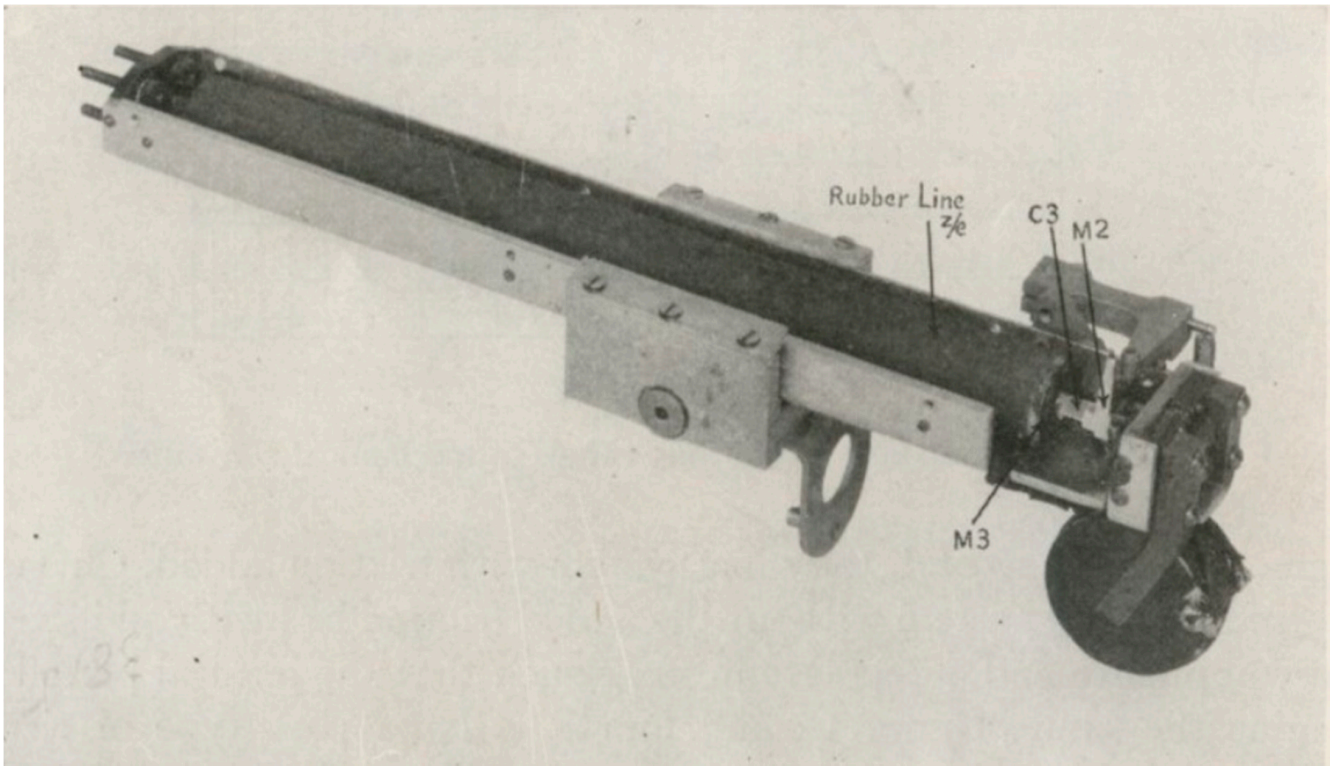

Figure 8. Bell Labs electromagnetic cutter used in the Westrex system.

Although in laboratory conditions and with nonstandard disc formats this system could achieve a flat frequency response from 35 to 8000 Hz, in order to guarantee compatibility with existing phonographs the Western Electric engineers had to compromise and adapt their system to the groove configuration inherited from the acoustic era discs, with the result that the frequency range on the commercialized system was reduced to 100 to 5000 Hz. This is exactly the same bandwidth limitation that we see in the Daily Mail campaign records analysing the frequency content of the digitised version.

There is an exceptional entrepreneurial feat behind the UK based Columbia Graphophone Company's use of the Westrex technology, since Western Electric did not want to license it to companies outside of the USA at the time. Columbia Graphophone general manager, Louis Sterling, after listening to some test discs produced with this innovative technology, recognized the enormous superiority of this new electrical process and decided to get his hands on it at all costs. He travelled to the USA in February 1925 and purchased with the help of a loan from JP Morgan bank the controlling parent company Columbia Gramophone Company based in the USA that was very troubled financially. Sterling established it as a branch of the UK company and used it to finally gain access to the Western Electric patents licensing [51,52].

Although not strictly relevant for the London Street Noises discs production, it is important to note that in the very same year, 1928, Columbia put in place the foundations for another milestone of its history. Since the royalty payments to Western Electric were very high, Columbia started the "head-hunt" for an engineer capable of working on an alternative, and in 1929 hired the English electronic engineer Alan Blumlein (one of the most influential inventors in audio, and father of the "stereo sound" as described later) [51]. As a result, Blumlein developed a "moving coil" cutting head as the electromechanical actuator responsible for the engraving, which improved greatly the sound quality and allowed Columbia to cancel the licensing contract with Western Electric. Until then, the competing cutters were indeed based on the "moving iron" technology, with higher distortion and narrower frequency bandwidth [51].

For what concerns the physical location of the recording equipment, although there are documented cases of mobile recording systems installed on vans used by Columbia, like the one used to record a funeral service in Westminster Abbey [53], we know through the Daily Mail articles of the time that the choice for the London Street Noises recordings was very different. In fact, they decided to use indoor rooms available in the immediate surroundings of the designed recording location to host the equipment. On Wednesday, 5 September 1928, the Daily Mail reports that a recording plant erected in the Stepney neighbourhood (near Aldgate) has started testing and provides an accurate description of this plant [25]. This consists of electric batteries to supply the power, ovens to soften the wax on the discs in preparation of the engraving, and vacuum tube amplifiers to amplify the microphone signal to the level necessary to drive the electromagnetic cutter. A diagram of this system is in Figure 9, and a picture from the article of the day is in Figure 10 [25]. Here, we can recognize the horizontal bar across the disc as the electromagnetic cutter, and a large horn probably used to playback the recording for monitoring purposes.

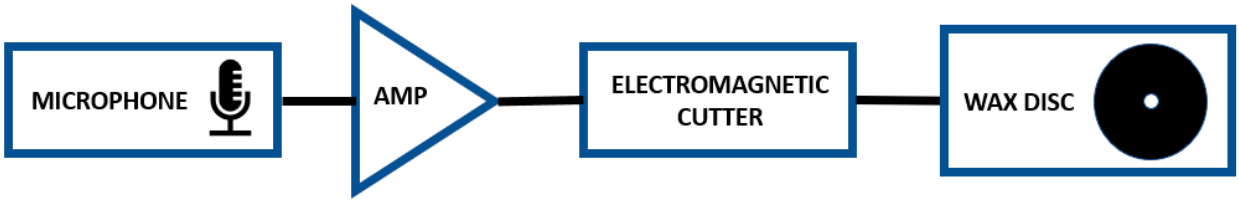

Figure 9. LSN recording system diagram.

Figure 10. LSN recording system—detail.

The microphone would be attached with a very long cable running from the equipment room to the street, often hanging from windows. This is for example visible in the pictures for three of the locations, Aldgate, Beauchamp Place, and St. George Hospital, in Figure 11 [26] and Figure 12 [8]. and Figure 13 [40] respectively.

Figure 11. Aldgate—microphone location.

Mrs. Helen Riou's shop in Beauchamp-place, off Brompton-road, where records of noises were taken. The arrow indicates the microphone.

Figure 12. Beauchamp Place—microphone location.

Figure 13. St. George's Hospital-microphone location.

"Experimenters on the street" were also able to remotely communicate with the operators inside the recording room to ask for the apparatus to start and stop the recording.

The microphone technology used was probably of the condenser type, and the recordings were monophonic, thus with no rendering of the spatial distribution of the sound sources.

It is worth noting that although there were cases at the time where more than one microphone was used, this was only done to have the possibility of mixing independently the relative levels of the recorded musical instruments or sound sources. The concept of stereophonic sound would arrive only in 1931 with Alan Blumlein's UK patent 394325 [54],

although he called it "binaural sound". The first commercial implementations of his invention became a reality in the late 1950s, when the patent had expired.

6. Conclusions

This paper presented for the first time what can be described as an important milestone project within the second wave of the history of the noise abatement campaigns in the UK. As shown in our historical analysis of the project and the elaboration on the acoustical technology that was available in the era, the London Street Noises campaign was a ground-breaking initiative and an illustrative case from many respects. Its significance in the context of the contemporary discourse on noise control and urban sound can be appreciated by recognizing its similarities with modern soundscape-based approaches that rely not only on the numerical evaluation of the sound pressure levels, but also on field recordings and offline presentation of the stimuli to research participants, the focus on the personal experiences and subjective descriptions of noise nuisances, and last but not least the attention to the engagement of the public for a more participatory development of policies and regulations.

In line with that original goal of raising awareness in the widest possible audience, and as a form of public and freely accessible research, the 1928 historical sound recordings and the more recent ones taken in occasion of anniversaries of the campaign, have been published online through the creation of a website, londonstreetnoises.co.uk.

The recordings can be accessed both on a sound-map which allows one to travel in space and time across the different eras, and in a section where all the locations are documented and commented.

It is worth mentioning that another website that made first available two of the LSN historical recordings (and many others past and present), is Ian Rawes' "London Sound Survey", accessible at the address www.soundsurvey.org.uk.

Future work is the quantitative and qualitative comparative analysis of the historical recordings with those taken in modern times at the same locations, the improvement of the sound quality of the digitized 1928 recordings, the research and analysis of other similar projects—if available—in other locations in the UK and worldwide.

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