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THE DISPUTED SOUND OF THE AURORA BOREALIS: SENSING LIMINAL NOISE DURING THE FIRST AND SECOND INTERNATIONAL POLAR YEARS, 1882–3 AND 1932–3

by

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This paper discusses heightened interest in the potential audibility of the aurora borealis during the First and Second International Polar Years (IPYs) of 1882–3 and 1932–3. Galvanized by a growing volume of local accounts expressing belief in the elusive noises, written by the inhabitants of the Shetland Islands, northern Canada, and Norway, auroral researchers of each era were determined to establish the objectivity of auroral sound. There was considerable speculation within the auroral research community as to whether the apparent noises were imagined or illusory, connected to discussions about the possibility of low-altitude aurorae. The anglophone auroral sound debate primarily played out within the official reports of IPY expeditions, the journal *Nature*, and a Shetland Island newspaper. I argue that the embodied senses were used exclusively to register the liminal sounds of the aurora across the two periods, despite developments in sound recording technologies, the primacy of mechanical objectivity, and instruments transported to the polar regions for the investigation of visual features of the phenomenon. This overlooked episode complicates narratives of polar science in the late nineteenth and early twentieth centuries by revealing a faith in the corporeal senses and the significant role of amateur observers.

Keywords: aurora borealis, sound, International Polar Year, polar science, senses

INTRODUCTION

> I am from Whalsay and remember on clear and frosty nights about thirty years ago the 'pretty dancers' (as we called them) coming in wide yellowish streaks in the N. E. sky. They would flit to and fro, making a noise as if two planks had met flat ways—not a sharp crack but a dull sound, loud enough for anyone to hear. We boys got so used to this that we never heeded the noise when the pretty dancers came out to clap their hands.[1]

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1 Peter Hutchison, 'Hearing the aurora', *The Shetland News*, 20 May 1933.

Relating vivid tales of audible aurorae from thirty years prior, this extract from a letter written by Shetland Islander, Peter Hutchison, was published in *The Shetland News* on 20 May 1933. Although unusual in its characterization of auroral sound as loud and easily discernible, persuasive reports such as this bolstered belief in the notion that, under the right conditions, noise could be perceived emanating from the northern lights. It was submitted in response to a call from the editor in tune with the heightened interest in the possibility of auroral audibility during the Second International Polar Year (IPY).

This paper discusses the late nineteenth and early twentieth century debate as to whether the apparent sound of the aurora, recorded by residents of northern latitudes and a small number of auroral researchers alike, was imagined, illusory, or objective. For decades it was a highly contentious issue, one that divided opinion, provoked lively discussion, and puzzled those who were enthralled by the mystery. The auroral sound debate had consequences for understandings of the altitude of aurorae and therefore knowledge of the composition of the upper atmosphere as well as the verification of folkloric stories, but it also captivated and intrigued on an aesthetic level. The First and Second IPYs of 1882–3 and 1932–3 acted as nodes wherein discussion of the possibility of auroral sound increased considerably. Within the anglophone IPY literature, the clearest articulation of the auroral sound debate is found in the national reports and official surveys of the First IPY and within two contrasting textual forums during the Second IPY: the academic journal, *Nature*, and a local Shetland Island newspaper, *The Shetland News*. The *Nature* articles reveal the formalized boundaries of the debate, while the letters to the editor style forum captures the curiosity of the aural phenomenon and the multiplicity of local testimony.

The two IPY enterprises, which took place fifty years apart, were collaborative transnational endeavours carried out to investigate the meteorology, geomagnetism, atmospheric electricity, ocean currents, and auroral phenomena of the polar regions.[2] Twelve countries participated in the First IPY, with twelve stations set up in the Arctic and two in Antarctica, whereas forty-four countries took part in the Second IPY, with twenty-seven stations established in the Arctic and none in Antarctica due to financial limitations resulting from the Great Depression. The aurora was a transnational research theme as a phenomenon that did not respect national boundaries. A chain of northern stations could also yield useful information by connecting the phenomenon with various meteorological and magnetic factors, whereas a single station could not provide comparable data.

Having consulted all First and Second IPY reports, it is clear that notes referring to the elusive sounds of the aurora are few in number and considered peripheral to the primary visual investigation of the phenomenon. The principal means of examining the intangible aurora in the 1880s were to make illustrative sketches and fill logbooks with details of its

2 Niels H. De V. Heathcote and Angus Armitage, 'The First International Polar Year', in *The histories of the International Polar Years and the inception and development of the International Geophysical Year: Annals of the International Geophysical Year* (ed. Sam Stuart), pp. 7–100 (Elsevier, Amsterdam, 2013); Cornelia Lüdecke, 'The First International Polar Year (1882–83): a big science experiment with small science equipment', *Proc. Int. Commission Hist. Meteorol.* 55–64 (2004); Roger D. Launius, James Fleming and David DeVorkin, 'Rise of global scientific inquiry in the International Polar and Geophysical Years', in *Globalising polar science: reconsidering the International and Geophysical Years* (eds Roger D. Launnius, James Rodger Fleming and David H. DeVorkin), pp. 1–9 (Palgrave Macmillan, London, 2010); Aant Elzinga, 'Through the lens of the polar years: changing characteristics of polar research in historical perspective', *Polar Rec.* **45**(235), 313–336 (2009); Susan Barr, Louwrens Hacquebord and Cornelia Lüdecke, 'Some IPY-2 Histories', in *The history of the International Polar Years (IPYS)* (eds Susan Barr and Cornelia Lüdecke), pp. 175–210 (Springer, Berlin, 2010); Cornelia Lüdecke and Julia Lajus, 'The Second International Polar Year 1932–1933', in *The history of the International Polar Years* (eds Susan Barr and Cornelia Lüdecke), pp. 135–174 (Springer, Berlin, 2010).

displays. For the Second IPY, the main methods included the collection of photographs from various Arctic stations, while auroral spectroscopy was put firmly on the programme's agenda. An allied concern as to whether the aurora could be captured accurately by pencil, painting, or photography existed within the visual IPY programmes, though this underlying anxiety did not influence an alteration of methods used to reproduce the phenomenon or investigate its properties.

Within the First IPY expedition reports, it was Sophus Tromholt and Major Henry Dawson who addressed the issue of auroral sound most ardently. In 1882, Tromholt, a Danish schoolteacher by training, established a base at Kautokeino, a Norwegian village close to the Finnish–Norwegian border, where he spent the year on his own, separate from the primary Danish expedition led by Adam Paulsen to Godthaab in Greenland. Although in direct contact with Niels H. C. Hoffmeyer, director of the Danish Meteorological Institute, and Henrik Mohn, director of the Norwegian Meteorological Institute, Tromholt was largely considered an outsider to contemporary Scandinavian scientific society. As such, the Danish government did not fund his IPY expedition, but Tromholt did receive support from the Norwegian Parliament, albeit only a quarter of his salary as a teacher, and his expedition was privately sponsored by Captain I. C. Jacobsen and the Norwegian businessman, C. Sundit. Dawson led the British expedition to Fort Rae, an old outpost of the Hudson's Bay Company on the northern tip of Great Slave Lake in Northwest Canada. Three men accompanied him for the duration of the First IPY from 1 September 1882 to 31 August 1883.

Interest in auroral audibility continued into the twentieth century, a testament to its enduring ability to enchant and perplex. Approaches to the auroral sound debate were remarkably similar in both the First and Second IPYs, with surveys of the local inhabitants of northern latitudes and the attentive listening of IPY researchers constituting the primary methods of research. The auroral scientist who addressed the problem most fervently during the Second IPY was Balfour Currie, a Canadian meteorologist and member of the department of physics at the University of Saskatchewan, who occupied a station at Chesterfield Inlet on the western shore of Hudson Bay in Northeast Canada with several of his colleagues, including Frank Davies. Carl Størmer, professor of mathematics at the University of Oslo, was the foremost auroral scientist of the 1930s and spent most of the Second IPY at various stations in southern Norway. Although he did not directly investigate auroral sound during the IPY programme, his articles on the topic, published in the 1920s and 1930s, were influential, altering the ways in which aural accounts were received.[3] Sydney Chapman, one of the world's leading geophysicists and later President of the Special Committee for the IGY, and George Clark Simpson, who became President of the British Meteorological Society in 1940, were deeply involved in the auroral sound debate of the early 1930s. Additionally, Clement J. Williamson, an amateur astronomer and resident of Scalloway, on the Atlantic coast of mainland Shetland, was one of the few non-professional voices of authority on the matter in the twentieth century.

I argue that the embodied senses were used exclusively to register the sounds of the aurora across the First and Second IPYs, despite developments in sound recording technologies, faith

3 Carl Størmer, 'The Aurora of October 15, 1926, in Norway and sounds associated with it', *Nature* **119**, 45–46 (1927); Carl Størmer, 'Photographic measurement of the great aurora of January 25–26, 1938', *Nature* **141**, 955–957 (1938); Carl Størmer, 'Progress in the photography of the aurora borealis', *Terrest. Magn. Atmos. Electr.* **37**, 475–477 (1932).

in mechanical objectivity, and instruments transported to the polar regions for the photographic and spectroscopic investigations of the phenomenon. I explore the aurora as an experiential phenomenon—as it was conceived of by the IPY scientists of the 1880s and 1930s—examining the way its impressions were sensed and communicated in each of the two periods, although its aural characteristics were transient, liminal, and difficult to elucidate. Moreover, this paper seeks to interrogate the broader position of bodily senses in Arctic fieldwork, especially since, as Martin Mahony and Samuel Randalls have recently pointed out, 'corporeality has often been missing from, or unevenly present in, our spatial histories of science'.[4]

The sensory turn began within the discipline of history in the 1990s, with such writers as Alain Corbin, Constance Classen, and Roy Porter historicizing perception in their works. It remains a 'vigorous mainstream enterprise'.[5] In terms of polar history, Kathryn Yusoff's exemplary article, 'Antarctic exposure: archives of the feeling body', traces the marks made by explorers to the Antarctic and the reciprocal inscriptions inflicted on their bodies, arguing that visualizing landscapes is a process mediated by pain and blindness as well as clear sightedness.[6] Yet, while the historical hegemony of vision in the west has been well documented, other means of perception have received considerably less scholarly attention.[7]

Research in the fields of cultural geography and anthropology has confronted this discrepancy wholeheartedly.[8] Emerging in the early 2000s, sound studies, focusing on the 'production and consumption of music, sound, noise and silence', have now become a dynamic area of interdisciplinary research.[9] Much work in the domain of sound studies has concentrated on the technologies of sound production. Alexandra Hui explores the impact of recorded music on the types of listening which came into being in the twentieth century.[10] Emily Thompson similarly charts behavioural changes in early twentieth century American society in response to the new 'soundscape of modernity'. *The Oxford handbook of sound studies*, edited by Trevor Punch and Karin Bijsterveld, is self-consciously ordered by different sites including the laboratory, clinic, home, and field, and interrogates how noise within these various spaces has been staged, reworked, edited, and consumed.[11] Together, these works argue for the consideration and reconfiguring of the relationship between sound, body and space. This theme of the literature is one that I will take up, in relation to the aurora, a phenomenon experienced through the senses and intrinsically tied to the polar regions.[12]

4 Martin Mahony and Samuel Randalls, 'Introduction: weather, climate, and the geographical imagination', in *Weather, climate, and the geographical imagination: placing atmospheric knowledges* (eds Martin Mahony and Samuel Randalls), pp. 3–22 (University of Pittsburgh Press, Pittsburgh, 2020), at p. 7.

5 Martin Jay, 'The senses in history', in *Senses and sensation: critical and primary sources*, vol. 2, *History and sociology* (ed. David Howes), pp. 63–70 (Bloomsbury, London, 2018), at p. 66.

6 Kathryn Yusoff, 'Antarctic exposure: archives of the feeling body', *Cult. Geogr.* **14**, 211–233 (2007).

7 David Howes and Constance Classen, 'Introduction: ways and meaning', in *Ways of seeing: understanding the senses in society* (eds David Howes and Constance Classen), pp. 1–17 (Routledge, Abingdon, 2013), at p. 1.

8 Deborah Dixon, 'Geographies of touch/touched by geography', *Geogr. Compass* **4**, 449–459 (2010).

9 Trevor Pinch and Karin Bijsterveld, 'New keys to the world of sound', in *The Oxford handbook of sound studies* (eds Trevor Pinch and Karin Bijsterveld), pp. 1–36 (Oxford University Press, Oxford, 2012), at p. 4.

10 Alexandra Hui, 'Sound objects and sound products: standardising a new culture of listening in the first half of the twentieth century', *Cult. Unbound: J. Curr. Cult. Res.* **4**, 599–616 (2012), at p. 600.

11 Pinch and Bijsterveld, *op. cit.* (note 9).

12 Emily Thompson, *The soundscape of modernity: architectural acoustics and the culture of listening in America* (MIT Press, Cambridge, MA, 2004), p. 2.

An embodied approach to the history of northern lights research has not before appeared within the IPY literature or within wider histories of polar exploration. Moreover, only three pieces of secondary research written in English exist on auroral sound, two of which are primarily scientific works themselves.[13] The other is Shane McCorristine's exploration of auroral sound accounts during the earlier British search for the Northwest Passage between 1818 and 1859, explaining the ways in which the aurora, and its apparent noise, enchanted and re-enchanted witnesses.[14] Through investigating the auroral sound debate during the First and Second IPYs, I draw attention to a dynamic, contentious—and yet overlooked—episode of polar history, and conclude by suggesting that the body, and more specifically the western male body, was perceived as an inherently useful instrument, even within the culture of precision technology which pervaded the atmospheric sciences of the late nineteenth and early twentieth centuries.

Auroral sound in the First International Polar Year

Sound and hearing were subject to scientific scrutiny in the nineteenth century. Parisian physiologist, François Magendie, studied the degeneration of aural perception with age and the pain associated with listening to high-pitched noises. In 1863 Herman von Helmholtz published *Sensations of tone*, a foundational work on acoustics and the sense of sound. William Wundt, the German physiologist generally considered the founding father of experimental psychology, published a treatise relating to the mind's differentiation of various tones in 1891.[15] Furthermore, only two years before the beginning of the First IPY the phonograph cylinder, an early device for the recording and reproducing of sound, was patented by Thomas Edison. It became commercially available, as did disc records, in the 1880s. Sound recording devices such as the phonograph introduced new modes of listening, most significantly for the purpose of this article: hearing noises recorded in the past. Unlike viewing a photograph which merely represents the visual experience of an earlier time, one can directly perceive the sounds of the past with aural recordings.[16]

In the preceding decades before the First IPY, the negative accounts relating to auroral sound were many. In fact, Alexander von Humboldt, acting as a barometer for the most up-to-date scientific thought of his time, concluded in 1845 that, 'the northern lights have become more silent since they have been examined more carefully with the eye and the ear'.[17] Just one year before the First IPY, George Burder—who had also written on the possibility of daylight aurorae, rainbows, and the optical illusion of witnessing stars disappear from view while observing even brighter stars—asked in an article printed in *Nature* whether apparent auroral sound could be a physiological phenomenon.[18] At a time

13 S. M. Silverman and T. F Taun, 'Auroral audibility', in *Advances in Geophysics* (eds H. E. Landsberg and J. Van Mieghem), pp. 155–266 (Elsevier, Amsterdam, 1973), at p. 208; Colin S. L. Keay, 'C. A. Chant and the mystery of auroral sounds', *J. R. Astron. Soc. Can.* **84**, 373–382 (1990).

14 Shane McCorristine, '"Involuntarily we listen": hearing the aurora borealis in nineteenth-century Arctic exploration and science', *Can. J. Hist.* **48**, 29–61 (2013), at p. 54.

15 Wilhelm Wundt, *Ueber Vergleichungen von Tondistanzen* (Druck von Breitkopf & Härtel, Leipzig, 1891).

16 M. G. F. Martin, 'Sounds and images', *Br. J. Aesthet.* **52**, 331–351 (2012), at p. 331.

17 Alexander von Humboldt, *Cosmos: a survey of the general physical history of the universe, part 1* (Harper & Brothers, New York, 1845), p. 60.

18 George F. Burder, 'Sound of the aurora', *Nature* **23**, 529 (1881), at p. 529.

when concerns about the objective reality of auroral noise were coming to the fore, Burder proposed a subjective cause for the apparent sound, akin to the hissing the brain conjures when a meteor is witnessed. His suggestion was not explicitly discussed by the auroral scientists of the 1880s, but Burder's article signalled what was to be a recurring tension in the literature on the topic: a deep uncertainty as to the sound's objective reality and a sceptical attitude toward accounts claiming it to be anything more than a psychological effect.

The aurora, after all, was a powerfully iconographic object of fascination in the public realm, inspiring poetry and art, a subject of folklore and weatherlore, and intrinsically connected to ideas of national self-esteem and identity.[19] It was also deeply embedded within the discursive framework of the Arctic, a literary and dreamlike space entangled with spiritual ontologies, on which fantasies were projected within the popular imagination of the late nineteenth and early twentieth centuries.[20] The Arctic was perceived as an enigmatic location, where mirages and illusions were rife and the project of creating knowledge was often ambiguous or uncertain. Indeed, Naval Officer John Ross was famously misled by a mirage appearing to show mountains, which he named the Croker Mountains, within Lancaster Sound during his search for the Northwest Passage.[21] Moreover, as Michael Bravo remarked in *North Pole: nature and culture* (2019), 'as all polar navigators learn, senses and instruments in high latitudes often prove unreliable, observations and measurements constantly uncertain.'[22] Naturally, this framework made it all the more vital to the IPY enterprise that reports of auroral sound could be trusted.

No acoustic recording devices were included in the itineraries of any of the First IPY expeditions, due to their novelty, expense, and concerns over their durability. Instead, drawing on long-term practices, the bodies of the various expedition members were relied upon to hear accurately and communicate their aural perception. Expedition members, who had been trained in auroral observation practices, would sit alone in silence for hours on end within either an auroral observational shelter, most commonly made from earth and corrugated iron, or a more permanent hut among the meteorological and magnetic instruments, watching, listening, and waiting for the aurora.

Tromholt was among the very few auroral researchers of the late nineteenth century who took reports of the evasive noises seriously. His willingness to accept the possibility of auroral sound likely stemmed from his relationship with his father, Johan Tromholt, who himself claimed to have heard the lights in the 1830s and 1840s. A customs clerk by profession, Johan Tromholt kept comprehensive notes of any aurorae he witnessed in his home town of Copenhagen and later in Jutland and the duchies of Schleswig and Holstein. Somewhat unusual for an amateur at the time, he even published an article in the journal *Wochenschrift für Astronomie, Meteorologie und Geographie* in 1860, detailing three

19 Robert Marc Friedman, 'Making the aurora Norwegian: science and image in the making of tradition', *Interdiscipl. Sci. Rev.* **35**, 51–68 (2013), at p. 56; Patricia Fara 'Northern possession: laying claim to the aurora borealis', *Hist. Workshop J.* **42**, 37–58 (1996), at p. 38.

20 Shane McCorristine, *The spectral arctic: a history of dreams and ghosts in polar exploration* (UCL Press, London, 2018), p. 12.

21 Clive Holland and James M. Savelle, 'My Dear Beaufort: a personal letter from John Ross's Arctic expedition of 1829–33', *Arctic* **40**, 66–77 (1987), at p. 67.

22 Michael Bravo, *North Pole: nature and culture* (Reaktion Books, London, 2019), p. 184.

Figure 1. Sophus Tromholt, 'Sophus Tromholt in Sami costume standing among the instruments in his outdoor observatory at Kautokeino', 1882–3, *University of Bergen Library*, ubb-trom-038.

occasions on which he perceived the sounds, indicating a true passion for the subject.[23] Johan Tromholt used the analogy of the quiet but rapid rubbing together of two pieces of paper to describe the unusual noises heard from northwest Copenhagen on 16 September 1838, 21 December 1840 and 6 May 1843 respectively.

Despite his father's encounters with the sound of the aurora, Sophus Tromholt (figure 1) never experienced the phenomenon first-hand. He stated in an 1884 *Nature* article about the aurora borealis in Iceland, which he visited to extend his research directly after the First IPY in October 1883, that 'neither here or in any other place have I heard the mystic auroral sound'.[24] During his time at Kautokeino during the IPY, Tromholt listened earnestly for the aurora in vain and spent much of his time calculating the height of the phenomenon to analyse the likelihood of soundwaves produced by the displays reaching the surface of the earth. To achieve these measurements, he worked with researchers residing at the Norwegian IPY station, led by Askel S. Steen and situated at Bossekop in Finnmark. Tromholt and members of the Norwegian expedition would identify prominent arcs to be observed simultaneously, determining the apparent height of the phenomenon using the position of the stars at each station before comparing their results. As the stations were situated at a known displacement, an estimate for auroral height could then be calculated. Although

23 J. P. Tromholt, 'Correspondenznachricht das Geräusch bei Nordlicht-erscheinung betreffend', *Wochenschrift für Astronomie, Meteorologie und Geographie* 237–238 (1860), at p. 237, and K. Moss, 'Sophus Peter Tromholt: an outstanding pioneer in auroral research', *Hist. Geo- Space Sci.* **3**, 53–72 (2012), at p. 55.

24 Sophus Tromholt, 'On the aurora borealis in Iceland', *Nature* **29**, 537–538 (1884), at p. 537.

Tromholt admitted that the rapid movement of aurorae created considerable uncertainties in his calculation method, he also announced in 1884 that the aurora borealis lay at a height of at least 100 km above the earth's surface in the Kautokeino–Bossekop plane.[25]

This result not only situated the aurora at too great an altitude for soundwaves emanating from the phenomenon to be transmitted and heard with human ears on the surface of the earth, but also put Tromholt into direct conflict with Paulsen, his Danish IPY counterpart in East Greenland. Paulsen claimed to have measured eight cases of the aurora between 19 and 68 km above the earth's surface and fourteen cases between 0.6 and 9.8 km during the IPY, significantly lower than displays observed in Norway.[26] Paulsen asserted that he and his companions had witnessed aurorae below the clouds first-hand, which Tromholt rejected as impossible.[27] Furthermore, in 1893 he published a drawing of an aurora observed on 15 November 1882 (figure 2) in contact with the hills southwest of the Godthaab station, visually bolstering his claim to have seen low aurorae with no indication of its abnormality in the accompanying caption, even by his own reckoning. Height measurements were just one aspect of their dispute, which came to a head in Paulsen's 1889 letter published in the *Bulletin of the Royal Danish Academy of Sciences*. In it, he critiqued Tromholt's theories about the variation of the aurora with the seasons and the sun's activity.[28] Nevertheless, despite the friction with his Danish colleague and his newfound scepticism with regards to auroral heights, Tromholt remained committed to the investigation of auroral sound.

Two years after the First IPY, in March 1885, Tromholt sent out several thousand letters to residents of all parts of Norway, asking whether the recipient or their acquaintances had ever heard the elusive sounds, and, if so, when and in what manner.[29] His survey was remarkable in the sense that it relied entirely on the embodied testimonies of the local population to provide insights about the phenomenon's aural capacity. It must be remembered that this was a period at the height of what has been termed a dedication to 'mechanical objectivity'—the use of instruments to reduce human intervention in navigating the world of ambiguous and enigmatic signals from nature.[30]

Other expeditions to the Arctic, such as the British Antarctic Expedition of 1875–6 led by Sir George Strong Nares, seven years prior to the First IPY, placed great emphasis on the use of instruments and rigorous observing practices. Norman Lockyer provided comprehensive instructions for the use of the spectroscope for solar and auroral observations; Henry Roscoe provided guidance for the collection of meteoric dust; and the expedition was supplied with an electrometer designed by William Thomson, 1st Baron Kelvin, for the accurate measurement of atmospheric electric field.[31] Within the broader scope of the physical sciences, physicist Henri Becquerel used photographic technologies to capture

25 Sophus Tromholt, 'Measuring the aurora borealis', *Nature* **29**, 409–412 (1884), at p. 412.

26 Adam Paulsen, 'On the height of the aurora borealis', *Nature* **29**, 337–338 (1884), p. 337; P. Stauning, 'Danish auroral science history', *Hist. Geo- Space Sci.* **2**, 1–28 (2011), at p. 12.

27 Paulsen, *op. cit.* (note 26).

28 Adam Paulsen, 'Contribution a notre connaissance de l'aurore boreale', *Bull. Acad. R. Dan. Sci. Lett.* 67–95 (1889), at pp. 70–71.

29 Sophus Tromholt, 'Norwegian testimony to the aurora-sound', *Nature* **32**, 499–500 (1885), at p. 499. Tromholt did not provide any information on how he chose the specific recipients of the survey.

30 Lorraine Daston and Peter Galison, *Objectivity* (Zone Books, Princeton, 2007), p. 124.

31 Trevor H. Levere, *Science and the Canadian Arctic: a century of exploration, 1818–1918* (Cambridge University Press, Cambridge, 2004), at p. 267.

Figure 2. Adam Paulsen, 'Aurora (multiple rayed-bands) observed to South-West from Godthaab on 15 November 1882 at 00h 30m', drawing in *Observations internationales polaires, 1882–83, Expédition Danoise: observations faites à Godthaab* (Chez G. E. C. Gad, Libraire de L'université, Copenhagen, 1893), p. 3.

radioactive emission from uranium salt in the 1890s and Arthur Worthington conducted water droplet experiments, employing the flash of a camera to isolate only part of the droplet sequence in the spring of 1894.[32] It is no coincidence that these experiments depended not on sight or memory but on the capturing and recording of phenomena using photographic technologies, rendering them in this new 'authentic' mode with a type of 'blind sight', which attempted to eliminate subjective interpretation.[33] Of course, the extent to which these experiments were truly objective is limited, considering they required the staging of apparatus, epistemic choices, and the presence of humans. Nevertheless, in aligning their work with the goal of mechanical objectivity, these scientists were positioned at variance to Tromholt's purposeful reliance on a qualitative survey based entirely on the documentation of the bodily senses.

32 Kelley Wilder, 'Visualising radiation: the photographs of Henri Becquerel', in *Histories of scientific observation* (eds Lorraine Daston and Elizabeth Lunbeck), pp. 349–369 (University of Chicago Press, Chicago, 2011), at p. 353; A. M. Worthington, *The splash of a drop* (S.P.C.K., London, 1895).

33 Daston and Galison, *op. cit.* (note. 30), p. 139 and for the disciplinary shift towards technoscientific methods within psychology in the United States in the 1880s: Deborah J. Coon, 'Standardising the subject: experimental psychologists, introspection, and the quest for a technoscientific ideal', *Technol. Cult.* **34**, 757–783 (1993); Deborah J. Coon, 'Testing the limits of sense and science: American experimental psychologists combat spiritualism, 1880–1920', *Am. Psychol.* **47**, 143–151 (1992).

Tromholt received 114 responses from his survey campaign. Of these, 92 expressed belief in the sounds, 53 claimed to have heard the noises themselves, 39 quoted the testimony of someone else, 21 answered that they had never heard the sounds, and 31 did not express a view either way.[34] Answers included analogous descriptions of the sounds as 'burning dried juniper', 'tearing silk' and 'the buzzing of a bee'.[35] Although varied, many of the responses characterized the noises as some mode of whizzing, crackling or hissing, often quiet sounds on the edge of perception. The number of affirmative responses and similarity of the reports naturally lent credibility to the view of the reality of the sounds, but the results did not galvanize any sort of shift in methodology or thinking about the aural properties of the aurora. John Rand Capron, the respected British solicitor, spectroscopist, and amateur astronomer, also conducted a survey, collecting auroral sound accounts throughout the north of the British Isles. Published three years before the First IPY in his 1879 study of the aurora and its spectra, he determined that the results were 'quite adverse to any proof of noises proper ordinarily accompanying aurora'.[36] Despite the growing volume of testimonies, auroral researchers of the era remained sceptical, displaying a distrust in evidence presented in this local, personal register.

Auroral sound was also discussed within the official observational report of the British Polar Year expedition to Fort Rae, published in 1886. Alongside a detailed log of auroral activity, Dawson, in charge of the expedition, noted that ordinarily not the slightest sound accompanies auroral displays. Yet, on one occasion during his twelve-month stay in northern Canada, he claimed to have heard the aurora himself. He likened the noise to 'a sharp squall of wind in the rigging on a ship', directly following the movement of the phenomenon.[37] It is significant that this finding was included within the official account of the expedition, signalling that it was intended to be considered carefully by the document's readers. As this was such a contentious and unverifiable statement, Dawson was relying on his reputation as a trustworthy observer to convince his audience, as virtual witnesses to his momentary embodied experience.[38]

Agnes Mary Clerke, renowned Irish astronomer, certainly seemed convinced by Dawson's account, noting that his was 'the first official confirmation of innumerable less authentic reports to the same effect'.[39] This likely reflects a confidence in assertions presented in the mould of western scientific discourse, published in a state-sponsored medium as opposed to a reluctance to believe indigenous testimonies, including those accounts collected by Tromholt and Capron. Believability was contingent on a particular body, that of a masculine Victorian explorer, only temporarily inhabiting the high-latitude region, with a rigorous regime of observations. By contrast, it is significant that the construction of credibility within a realm such as spiritualism relegated the body as an impediment to the creation of critical knowledge. In John Tyndall's well-known repudiation of the occult after

34 Tromholt, *op. cit.* (note 29).

35 *Ibid*.

36 John Rand Capron, *Aurorae: their characters and spectra* (E. & F. N. Spon, London, 1879), p. 34.

37 British International Polar Year Expedition, *Observations of the International Polar Year expeditions, 1882–83: Fort Rae* (Tribuner & Co., London, 1886), *MBLWHOLI Library*, p. 253.

38 S. Shapin and S. Schaffer, *Leviathan and the air-pump: Hobbes, Boyle and the experimental life* (Princeton University Press, Princeton, 2011), p. 61.

39 A M. Clerke, 'L'Aurore boréale étude générate des phénomènes produits par les courants électriques de l'atmosphère resultate der polarlicht-beobachtungen angestellt im winter 1882 und 1883 auf den stationen kingua fjord und nain', *Nature* **35**, 433–436 (1887), at p. 435.

his attendance at an unsuccessful séance in 1864, he threw scorn on the idea that mediums were 'sensitive' to the spiritual world and could communicate through such means as vibrations in the floor.[40] These occult spaces could not compete in terms of legitimacy with the laboratory, such as that of the Royal Institution, where Tyndall had attained the position of Professor of Natural Philosophy, or the 'natural laboratory' of the remote Arctic field site, which was necessarily restricted, allowing privileged access to the auroral phenomenon.[41]

Nevertheless, Dawson's testimony was an exception rather than the rule, posing him a major challenge. No other auroral researcher of the First IPY claimed to have heard the noises, and observers stationed at Point Barrow—the northernmost point of Alaska and Spitzbergen, an island within the Svalbard archipelago—explicitly stated that no sound was heard despite preferable conditions in 1882–3.[42] Despite Dawson's sincerity and reputation, he did not influence a wholesale shift in the way the auroral sound debate was approached in the period directly after the First IPY.

Although not a primary feature of IPY auroral research, the issue of apparent auroral sound was contemplated extensively in the years surrounding the First IPY. The period saw the first systematic studies of the aural phenomenon, with surveys collecting and assessing local experiential knowledge and several official IPY reports including examinations of auroral sound, albeit with only Dawson writing in the affirmative. There remained, however, a sense of scepticism towards testimonies of auroral noise; there was neither a consensus over the form the noises were alleged to take, nor an agreed-upon explanation for the elusive sounds.

Auroral sound in the Second International Polar Year

By the time of the Second IPY of 1932–3, the problem of auroral noise was still unresolved. In his 1932 outline of the work scheduled to take place during the Second IPY, Malcolm Rigby wrote for the *Bulletin of the American Meteorological Society* that auroral sound was 'one of the most disputed points not only among scientists but among laymen as well', revealing the strength of the debate as well as its enduring mystery.[43] The incidence of audible aurorae was understood to be rare; it was estimated among observers who believed in the sounds that only 5% of violent northern lights displays produced them.[44] It was hoped, therefore, that the thirteen-month IPY would provide some answers. Chapman considered the Second IPY a unique opportunity to research the connection between

40 Tatiana Kontou, *The Ashgate research companion to nineteenth-century spiritualism and the occult* (Routledge, Abingdon, 2016), p. 42; Richard Noakes, *Physics and psychics: the occult and the sciences in modern Britain* (Cambridge University Press, Cambridge, 2019), p. 52.

41 Vanessa Heggie, *Higher and colder: a history of extreme physiology and exploration* (University of Chicago Press, Chicago, 2019), p. 6.

42 William Healey Dall, Asa Gray, John Murdoch, Patrick Henry Ray, Charles V. Riley, Charles A. Schott, *United States Army Signal Corps, Report of the International Polar Expedition to Point Barrow, Alaska in response to the resolution of the House of Representatives of 11 December 1884* (G. P. O., Washington, 1885), Gerstein Science Information Centre, University of Toronto, p. 23; and H. Hildebrandsson, 'The aurora in Spitzbergen', *Nature* **38**, 84–85 (1888), at p. 85.

43 Malcolm Rigby, 'Recent research of the aurora and the work for the Second International Polar Year', *Bull. Am. Meteorol. Soc.* **13**, 195–200 (1932), at p. 197.

44 C. S. Beals, 'The audibility of the aurora and its appearance at low atmospheric levels', *J. R. Astron. Soc. Can.* **27**, 184–200 (1932), at p. 198.

auroral sound and unusually low aurorae. He asserted that 'with the better organisation of auroral observation which it is hoped will be achieved during the proposed new Polar Year, there is more chance that opportunities for critical examination of these appearances will occur'.[45]

With a more closely focused geophysical agenda than its predecessor, the Second IPY aimed to 'provide strictly comparable observational material' of 'meteorological, magnetic, auroral and atmospheric electrical phenomena'.[46] Auroral photography had advanced significantly since the First IPY. A camera built specifically for capturing the northern lights was designed by Ole Andreas Krogness, with the help of Størmer, and put to use in the 1910s. *The photographic atlas of auroral forms and scheme for visual observations of aurorae*, published by the International Geodetic and Geophysical Union, stated that 'the method which gives the most complete and exact results is the photographic one, and this method should be used if there is any possibility of doing so'.[47] Both the atlas and the Krogness–Størmer camera were sent to every station participating in auroral observations during the Second IPY.

Auroral spectroscopy, too, saw progress in the intervening fifty years between the two programmes. Various spectroscopes, some of particularly high dispersion and light-gathering power, including two installed on the roof of the Tromsø auroral observatory in northern Norway, were transported to the various Second IPY stations to find the frequencies of auroral radiation. Although considered of secondary importance, listening out and documenting any strange noises associated with the lights was a practice integrated into the IPY undertaking.[48] Significantly though, it was still the bodies of expedition members travelling to the Arctic which constituted the primary medium by which auroral sound was to be registered, despite the transportation of these other advanced instruments to the polar sites. This is more surprising than the reliance on the senses during the First IPY, considering that acoustic technologies had also advanced since the nineteenth century.

Replicating the techniques of Tromholt and Capron, Currie and Davies conducted an extensive survey on the topic of auroral sound from their base at Chesterfield Inlet. They asked the local inhabitants of the west coast of Hudson Bay, including traders, policemen, and missionaries, whether they had ever heard sound accompanying the northern lights. Setting up an overt dichotomy in the description of their results, Currie and Davies detailed the answers of the indigenous population and 'white people' separately.[49] They demoted the significance of indigenous testimony, arguing that it 'may be faulty and have induced a greater susceptibility to a subjective effect'.[50] Despite this distinction, members of all groups claimed to have heard the lights. Particularly frequent accounts originated from Burrel on Hudson Straits, Harrison on the east coast of Hudson Bay and in the region between Chesterfield Inlet and the Churchill River, albeit very few had heard the sounds at Baker Lake and none could recall the sounds from Southampton Island. In the testimonies Currie and Davies received there was little correlation between unusually

45 Prof. S. Chapman FRS, 'The audibility and lowermost altitude of the aurora polaris', *Nature* **127**, 341–342 (1931), at p. 341.

46 British National Committee for the Polar Year, 1932–1933, *Some general characteristics of aurora at Fort Rae, N.W. Canada, 1932–1933* (Percy Lund, Humphries & Co. Ltd, London, 1937), p. v.

47 International Geodetic and Geophysical Union, *Photographic atlas of auroral forms and scheme for visual observations of aurorae* (A. W. Brøggers Boktrykkeri, Oslo, 1930), p. 19.

48 Rigby, *op. cit.* (note 43), p. 197.

49 F. T. Davies and B. W. Currie, 'Audibility of the aurora and low aurora', *Nature* **32**, 855–856 (1933), at p. 856.

50 Davies and Currie, *op. cit.* (note 49).

Figure 3. 'Balfour Currie and John Rae at Fort Sik Sik, a sod hut used for auroral observation twenty miles from the main Chesterfield Base.' University of Saskatchewan Archives, B-13, 8×8 cm lantern slide (digitized 2002).

low aurorae and the sounds, but an almost universal association between the noises and synchronous, rapidly moving aurorae positioned directly overhead. In 1933, the Dominion Astrophysical Observatory in British Columbia collected 141 letters containing similar accounts, thus reinforcing the auroral sound narrative.

Currie also kept a diary of unusual optical and acoustical phenomena throughout the Chesterfield expedition, clearly hoping to hear the aurora himself (figure 3). He included second-hand accounts of 'whistling' or 'rustling' accompanying some displays, and he even retold a story of the aurora descending so low that it killed a small number of people, which he noted could have been due to the destructive effects of lightning.[51] Crucially

51 Balfour Currie, *Record of optical, acoustical and unusual phenomena*, notebook 1932–1933, edited transcript of the diary as it appeared in the #35, Spring 1987 issue of *The Musk-ox*, published by the Department of Geological Sciences at the University of Saskatchewan, p. 53.

though, no one involved in the survey had heard the aurora in the winter of 1932–3, leading Currie and Davies to conclude that they had resided in the region during a particularly 'quiet' year. The exception was the account of John Rae, an assistant observer on the Canadian IPY expedition, who claimed to have heard auroral sounds on 20 March 1933, asynchronous with the phenomenon's movement.[52] Both Currie and Edwards were engaged in parallactic photography at the time and listened unsuccessfully for the sounds, although they witnessed the 'brilliant greenish-white flashes' darting overhead. Introducing another subjective factor into the debate, they noted that they may have been unable to perceive the sounds 'due to less sensitive hearing', compared to the 23-year-old Rae.[53] The height determinations calculated from the photographs on the night showed no unusual displacement of the phenomenon. No further comment was addressed to Rae's record, presumably because the Chesterfield team was awaiting supporting evidence from other research groups involved in the IPY.

Lending some credibility to the theory of auroral sound, Størmer published two letters that he had received from his colleagues claiming to have heard the noises in 1926 and 1938, respectively. On 15 October 1926, Hans S. Jelstrup was observing polar stars atop Voxenaasen hill near Oslo. In one of his breaks, he witnessed one of the 'most splendid' aurorae he had ever seen; a photograph taken of the phenomenon at 19h 5m 45s on the night from Oslo to the west is represented in figure 4.[54] Hans Jelstrup and his assistant, G. Jelstrup, went outside to watch the yellow-green fans of the light display at 19h 15m GMT and both noticed a 'very curious faint whistling sound distinctly undulatory, which seemed to follow exactly the vibrations of the aurora'.[55] Their description alludes to the almost imperceptible nature of the sounds. Returning after they had finished their astronomical work, the noises had ceased and they noticed 'that the atmosphere was as if swept clean from statics and disturbances'.[56] Published in 1927, this narrative may have motivated interest in the phenomenon and emboldened IPY scientists to more readily believe aural reports, given that Størmer, an authority within the auroral science community, endorsed the account. Størmer also published an article in *Nature* in 1938 detailing the experience of his assistant, Mr Tjönn, hearing the lights at the Njuke Mountain station in Tuddal, Norway. On 25 January 1938, Tjönn claimed to have heard a sound like 'burning grass or spray' for approximately ten minutes following the movement of the aurora.[57] This second account, approved by Størmer, likely also reinforced belief in the possibility of auroral audibility in the latter half of the 1930s.

Størmer's retelling of Tjönn's experience was invoked by Williamson in the auroral sound debate which played out in *The Shetland News*. Williamson was a well-connected Shetland Island photographer, writer, and amateur astronomer, residing in Scalloway (figure 5). He corresponded with astronomers at the Mount Wilson observatory as well as with the author H. G. Wells on the subject of time travel. As one of the few amateurs directly involved in the auroral sound debate during the 1930s, Williamson's contribution was taken seriously

52 Davies and Currie, *op. cit.* (note 49).

53 Ibid., p. 856; Frank Davies, 'The Canadian Second Polar Year expedition to Hudson Bay, 1932–33', University of Saskatchewan, University Archives & Special Collections, J. E. Kennedy fonds, MG 102 additionals, box 10, at p. 2–3.

54 Størmer, *op. cit.* (note 3, 'The Aurora of October 15'), at p. 45.

55 *Ibid.*

56 *Ibid.*

57 Størmer, *op. cit.* (note 3, 'Photographic measurement of the great aurora of January 25–26, 1938'), at p. 956.

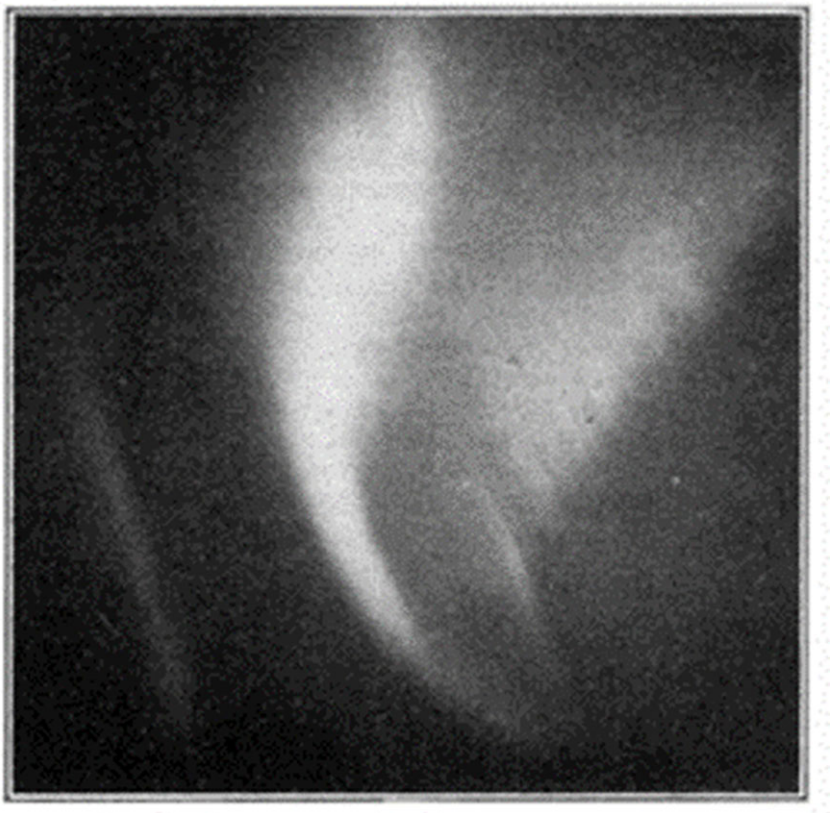

Figure 4. 'Auroral Curtains photographed on 15 Oct 1926', in Carl Størmer, 'The Aurora of October 15, 1926, in Norway and Sounds Associated with it', *Nature* **119** (1927), p. 45.

by some of the leading scientists of the era. Having received a letter from Størmer in 1938, Williamson recounted Tjönn's description in a letter to the editor of *The Shetland News*, revealing that it was deeply 'gratifying' to relay the report in support of his own belief in objective auroral sound.[58] Williamson had previously submitted a report to *The Shetland News*, following an appeal by the editor in 1933 to receive accounts of the noises from the region and beyond, at the height of interest in the phenomenon during the Second IPY. Recalling a still night in October 1926, he asserted that he had heard 'the sound a cane makes when drawn swiftly through the air, just a low murmuring swish, drumming and continuous'.[59] Unusually, Williamson did not claim to perceive the sound simultaneously with the flashes of light.

Williamson's account was published in *The Shetland News*, among a multitude of others in 1933. Using wording similar to that received by Tromholt in his survey, one letter alluded to

58 C. J. Williamson, 'The aurora', *Shetland News*, letter to the editor, 1938, D1/591/2a/2, 3, 6a, Shetland Museum and Archives.

59 C. J. Williamson, 'Hearing the aurora', *Shetland News*, letter to the editor, 1933, D1/591/2a/2, 3, 6a, Shetland Museum and Archives.

Figure 5. 'Clement J. Williamson', Scalloway's people at Scalloway Museum, Shetland Mainland (http://www.scallowaymuseum.org/scalloways-people.html).

the gentleness of the sound, likening it to the noise of 'rustling silk'.[60] This anecdote was penned by Shetland Islander Edward Dixon, having heard the sound on the island of Orkney in 1917. Mrs MacBride, another islander, wrote in about her experience living in Ottawa for a number of years where she remembered hearing a faint 'crackling noise' accompanying the more brilliant displays.[61] By contrast, the extract from a letter by Peter Hutchinson, with which this article opened, spoke of a more intense sound 'as if two planks had met flat ways—not a sharp crack but a dull sound, loud enough for anyone to hear'.[62] This description of a louder noise, uncommon among the aural testimonies, is suggestive of the inescapability of auroral sound, perhaps because conditions were optimal

60 Edward Dixon, 'The aurora', *Shetland News*, letter to the editor, D1/591/2a/2, 3, 6a, Shetland Museum and Archives.

61 Mrs MacBride, 'Music of the Aurora', *Shetland News*, newspaper article, *ca* 1930, D1/591/2a/2, 3, 6a, Shetland Museum and Archives.

62 Hutchison, *op. cit.* (note 1).

for its transmission. These vivid and personal recollections, written in the experiential idiom and all somewhat congruent, constituted a substantial piece of evidence in favour of auroral sound during, and in the years surrounding, the Second IPY. It is significant that experiences from previous decades were still relevant in the 1930s; the rarity and liminality of the aural phenomenon meant that its nature could only be uncovered over a number of years.

As well as a space for exchanging auroral sound reports, *The Shetland News* acted as a forum for the more detailed discussion of the possible mechanism of auroral sound through Williamson's correspondence. Williamson forwarded a copy of the observations taken from the Lerwick observatory and accounts of Shetland Islanders to eminent radio physicist, Sir Oliver J. Lodge, in 1933. Lodge commented that although it was not impossible for the sound to be objective, 'it is difficult to be certain whether it is a suggestion due to the vividness of the appearance' of the aurora.[63] Here Lodge pinpoints the first of two dominant themes of the sound debate: the possibility that the sounds were imagined, conjured by the mind. It was noted by Williamson, however, that if the brain produced a psychological sound because it expected there to be one, this should be the case with every aurora, not just with the most violent displays.[64]

Lodge clearly took Williamson's collection of notes seriously because he deemed them worth forwarding to Simpson, at the time working as the director of the Meteorological Office in London. As published in *The Shetland News*, Simpson replied stating that 'whether or not aurora is accompanied by sounds is a problem which has been very much discussed by men of science and even yet no generally accepted conclusion has been reached.'[65] Because all research so far indicated that the aurora occurred at approximately 100 km above the earth's surface, Simpson concluded that 'it would be physically impossible for sounds to be generated which could be heard on the earth's surface'.[66] As such, Simpson elucidated the second major sticking point of the debate: the impracticality of auroral sound reaching earth, especially travelling fast enough to be heard simultaneously with the movement of the lights.

A further discussion focused on low aurorae took place between Simpson, Chapman, and Axel Corlin, a Swedish physicist working on cosmic radiation at the Lund Observatory, in *Nature* between April 1931 and November 1932. Corlin began by detailing an aurora he had witnessed on 16 November 1929 at Abisko, Sweden, which he claimed appeared 'below the clouds … only a few thousand meters above the ground'.[67] Although he heard no noise, the example suggested a potential explanation for auroral sound. Published one month later, Simpson's paper attributed Corlin's narrative to an ocular illusion, citing his own experience witnessing aurorae at Karasjok, Norway, between October 1903 and September 1904.[68] Although Simpson relied on observations taken twenty-seven years earlier, he claimed to be able to recollect the circumstance perfectly and argued that the illusion he experienced was 'practically identical' to that which Corlin recounted.[69] The aurora appeared to be positioned below the clouds, illuminating the cloud where the two

63 Williamson, *op. cit.* (note 58).
64 *Ibid.*
65 *Ibid.*
66 *Ibid.*
67 Axel Corlin, 'Observations of a low altitude aurora and simultaneous phenomena', *Nature* **127**, 553–554 (1931), at p. 533.
68 G. C. Simpson, 'Low altitude aurora', *Nature* **127**, 663 (1931), at p. 663.
69 Simpson, *op. cit.* (note 67).

met, whereas in reality the bright patches were openings in the cloud, through which the stars could be seen. In recounting his experience, Simpson appealed to the virtue of careful observation, mentioning that it took 'a long time to make quite certain of this'.[70]

Corlin replied with another article, his claim now bolstered by a second account of a low-altitude aurora in Norwood, Canada, on the same day as his own.[71] Chapman, praising Simpson as a 'first-rate observer', referenced three more incidences wherein the meteorologist had demystified cases of low aurorae, while accompanying Robert Scott's Terra Nova Expedition in 1910.[72] This, Chapman argued, did not 'dispose of the possibility' of low aurorae but emphasized 'the need for caution in accepting reports even from the most trustworthy and convinced observers'.[73] It was trained, disciplined hearing in the western scientific mode which was valued in verifying the objectivity of low aurorae, and thus the possibility of auroral sound, even if the evidence relied upon was decades in the past. Overall, after the Second IPY, the auroral research community remained unconvinced of the existence of objective auroral sound.

The auroral sound debate resolved?

Ultimately, the auroral sound debate was settled within neither the First nor the Second IPY, despite it being a much-discussed topic in both eras. Reports from both enterprises still constitute useful evidence within the more modern exploration of the aural phenomenon. The answer that garnered the most support in the twentieth century was first tentatively suggested in 1923 by Clarence Chant, a well-known Canadian astronomer who took part in Sir Arthur Eddington's 1919 solar eclipse expedition and who presided over the Royal Astronomical Society of Canada from 1904 to 1907. At the end of his 1923 article, 'The Audibility of the Aurora', which was primarily dedicated to publicizing previously overlooked accounts of auroral sound, Chant proposed that the noises could be produced by a mechanism similar to that of a brush discharge.[74] He argued that the motion of the lights alters the earth's magnetic field and induces changes in the electrification of the atmosphere, even at a significant distance. This electrification produces a crackling sound much closer to the earth's surface, with transduction occurring in the observer's clothes or spectacles or possibly in surrounding objects including fir trees or the cladding of buildings. Within this hypothesis, auroral sound is intrinsically an embodied experience; the very act of an individual being in the Arctic, wearing clothing through which the electrical discharge could travel, brought auroral sound into existence. Such a personal, proximal, and almost tangible experience of the Artic noises vindicated the corporeal approach of IPY investigations. Chant's theory correlated well with many accounts of auroral sound, and the theory is also supported by occasional reports of the smell of ozone accompanying northern lights displays.[75]

70 *Ibid*.

71 Axel Corlin, 'The low altitude aurora of Nov. 16, 1929', *Nature* **127**, 928 (1931), at p. 928.

72 Chapman, *op. cit.* (note 45), at pp. 341–342 and G. C. Simpson, 'Auroral observations in the Antarctic', *Nature* **102**, 24–25 (1918), at pp. 24–25.

73 Chapman, *op. cit.* (note 45), p. 341.

74 C. A. Chant, 'The audibility of the aurora', *J. R. Astron. Soc. Can.* **7**, 273–284 (1923), at p. 284.

75 Silverman and Taun, *op. cit.* (note 17), p. 193.

Without referencing Chant's work, Størmer tentatively put forward a similar theory in 1927, asserting that electrostatic discharges in the Arctic surroundings, including trees and antennae, could be responsible for the sounds.[76] Nevertheless, despite the fact that surveys and crowdsourcing formed a crucial part of the exploration of the phenomenon, Chant's 1923 paper in the well-respected *Journal of the Royal Society of Canada* was entirely overlooked in the literature of the Second IPY; no mention of brush discharges was made within the IPY publications whatsoever. Nor did Chant's obituary, written after his death in 1956 by John Heard, include any mention of his auroral sound hypothesis, indicating that it was a peripheral aspect of his scientific career.[77] Indeed, Chant's article has only been cited six times, the first of which was as late as 1973 by S. M. Silverman and T. F. Taun.[78] Silverman and Taun revisited the evidence of auroral sound and analysed all the causes put forward since the nineteenth century, concluding, much like Chant, that brush discharges were the most likely explanation.

Since the Second IPY, interest in the aural phenomenon has ebbed and flowed. In more recent years, a group at Aalto University in Helsinki, Finland, led by Unto K. Laine has taken up the mantle of investigating the 'eerie sounds' of the aurora.[79] In the year 2000 they set up sensitive outdoor recording devices and a parabolic reflector to increase the vertical scope of the apparatus at Sodankylä, a small village in Northern Finland used by the Finnish research group during the First IPY. An estimate for the source of the sound held that it occurred, surprisingly, at 70 m above ground level. To account for this result, Laine has hypothesized that the sounds are created by discharges, similar to brush discharges, within an inversion layer of the atmosphere, a region wherein the temperature increases rather than decreases with greater distance from the earth's surface. Nevertheless, Laine states that his hypothesis may be one among a plurality of possible causes for the ethereal sounds, and questions remain, including how the discharging mechanism is triggered.[80]

On a different tack, the sound of the aurora has also been explored for its aesthetic value in the twenty-first century, inspiring musical compositions and laying the foundation for novel ways of interacting with its electromagnetic signals. Ēriks Ešenvalds, the Latvian composer, included journal extracts from nineteenth century accounts of the aurora written by American explorer, Charles F. Hall, and Norwegian explorer and statesman, Fridjtof Nansen, in his composition, *Northern lights.*[81] The words of the reports are interwoven with the only known Latvian folksong recording the aural phenomenon, sung by a tenor solo. The composition also makes use of tone chimes and tuned glasses filled with water to create an eerie ringing sound reverberating throughout the piece, making manifest the imagined sensations and emotions of experiencing an acoustic aurora. The recent BBC3 radio programme, 'Between the ears: songs of the sky', broadcast on Boxing Day 2020,

76 Størmer, *op. cit.* (note 3 'The aurora of October 15'), at p. 45.

77 J. F. Heard, 'Clarence Augustus Chant', *J. R. Astron. Soc. Can.* **51,** 1–4 (1957).

78 Silverman and Taun, *op. cit.* (note 17).

79 Unto Kalervo Laine, 'Auroral Acoustic Project – a progress report with a new hypothesis', Paper presented at the Baltic–Nordic Acoustic Meeting BNAM, 1–8 (2016), at p. 1.

80 Unto K. Laine, 'Auroral crackling sounds and Schumann resonances', *Proc. Int. Cong. Sound and Vibration, ICSV 2019*, 1–8 (2019).

81 Dina Lenstner, 'Due North: Ēriks Ešenvalds and aurora borealis as a claimed artistic space', *GESJ: Musicol. Cult. Sci.* **1**, 11–17 (2019), p. 13.

traces the remapping of very low frequency (VLF) radio recordings of the northern lights on to the audible spectrum by Alaskan biologist, Karin Lehmkuhl Bodony, and Alaskan composer, Matthew Burtner.[82] It was this instrument, the VLF radio receiver, which made hearing the aurora possible, transmitting the chirps, crackles and squeaks of the aurora's radio waves into a frequency audible to the human listener, and yet it was done for the very embodied and personal purpose of making audible art.

Conclusion

The exploration of auroral sound during the First and Second IPYs was undoubtedly an embodied practice based exclusively on the corporeal senses. It was the inherent experientiality of witnessing the aurora borealis, its apparent evasion of reproduction and the rarity and liminality of its sounds which prompted this focus on the human body. The fundamental otherworldliness of polar phenomena meant that the senses were intrinsically implicated in their construction because occurrences such as the aurora could not be captured meaningfully without the affective emotions and bodily sensations which were experienced with it. Despite the development of acoustic technologies and the dominance within the physical sciences of epistemologies based on mechanical instruments, eliminating the interference of human interpretation, the bodies of researchers and northern populations were solely relied upon to register the phenomenon during the 1882–3 and 1932–3 programmes.

Perhaps much more surprising, the Second IPY saw no advances or alterations in the practices of detecting auroral noise, even though equipment was transported to the Arctic for spectroscopic and photographic investigations of the lights and sound recording devices had advanced considerably in the 50-year interim. This could be said to reflect the secondary importance of the auroral sound debate, but more likely, given the volume of literature produced on the issue, researchers of the Second IPY trusted the methods of fifty years prior and hoped to expand the surveys and chances of detecting auroral sound corporeally. The body became an instrument, a credible source of knowledge creation—more so than any technological device, despite, or perhaps because of, the place of the Arctic as a realm of illusion and uncertainty in the western imaginary. The significance of the aural sense in this study lends credence to the view that the body mattered to the late nineteenth and early twentieth century physical sciences, at the crossroads with Arctic exploration—a notion more commonly 'restricted to the history of medicine and the science of life and human difference.'[83]

The two IPYs acted as nodes for the auroral sound debate, constituting two moments wherein the ethereal noises were discussed in journals, reports, and letters to a much greater degree than during the intervening years or before or after the period in question. The First IPY saw the issue recorded not just as an object of mythology but as a real possibility; the aurora emerged as a phenomenon to be known, documented, and understood. Nonetheless, the debate attracted greater attention in the 1930s, with high-profile scientists engaging with the topic and discussion spreading beyond merely the IPY

82 Kate Bissell, Karin Lehmkuhl Bodony and Matthew Burtner, 'Between the ears: songs of the sky', BBC Radio 3, first broadcast 24 December 2020 (https://www.bbc.co.uk/programmes/m000qhj3).

83 Mahony and Randalls, *op. cit.* (note 8), at p. 8.

reports. Both the more local *Shetland News* and the academic journal *Nature* acted as forums for the serious discussion of auroral sound during the Second IPY. The debate was more open to amateur participation than ocular investigations of the aurora, both in terms of the contributions of Tromholt in the First IPY and Williamson in the Second as well as crowdsourcing practices within both endeavours. The extreme location of auroral observation widened participation to some degree by involving a select few experts with lived experience insofar as they could engage with western scientific discourse, although of course restricting access to those without the means or desire to travel to high latitudes.

Concerns regarding the objective nature of the noises remained at the forefront of IPY auroral discourse in both the 1880s and 1930s, with possible explanations for the phenomenon put forward including the psychological conjuring of the sounds and polar illusions. The aurora's elusive and mysterious nature, alongside its ability to deceive and be sensationalized, made the veridical perception and communication of its aural features all the more crucial. The credibility of auroral sound reports hinged on both the perceived trustworthiness of observers and their conformity with the growing literature on the topic. It was the knowledge produced from IPY expedition members, temporary male inhabitants of the land, which was trusted with verifying the accuracy of local testimony. Although sought through surveys and calls for letters to the press, the experiences of local individuals were devalued, even when together they represented a significant and corroborated body of evidence.

This paper has drawn attention to a key episode in auroral history—a subject to which much time and effort was afforded during the 1880s and 1930s and one which has been very little discussed in the secondary literature of the IPY or more widely. It has bridged the gap between sensory registers and IPY research, although much room is left to explore embodied practices within histories of polar exploration. An interesting avenue for further research may also be the longer history of auroral sound within high-latitude mythology and folklore. Overall, the auroral sound debate complicates the straightforward notion of polar science as a purely professional practice based on the use of precision instruments in the late nineteenth and early twentieth centuries, in tune with the popularity of mechanical objectivity and trends within the physical sciences. The Arctic came to be seen as a space in which the body, specifically the western male body, could be relied upon to produce valuable and sometimes remarkable knowledge of phenomena that were so ambiguous and strange that they could only be made sense of in a way that was wrapped up in human corporeal perception.

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