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Primal Listening: Human Minds and Animal Ears in the Age of Comparative Anatomy

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Abstract Approaches to different listening practices rarely extend beyond human ears. During the nineteenth century, anatomists' fascination with non-human hearing emerged in tandem with the professionalization of comparative anatomy. This existed in tension with the professionalization of European music criticism, where the only model for listening was human. Theories of sensationalism, developed particularly in Feuerbach's and Marx's writings on the human senses, grounded an anthropocentric outlook, yet numerous commentators considered animal hearing as materially related to that of humans. This article traces the process of decentring human listening. It uncovers a discourse on the materiality of the senses, and asks when did the penny drop that human hearing was neither the only aural reality, nor necessarily the 'highest' in the natural world.

Pray you tread softly, that the blind mole may not | Hear a footfall.

Shakespeare[1]

The real in its reality or taken as real is the real as an object of the senses; it is the sensuous. Truth, reality, and sensation are identical. Only a sensuous being is a true and real being.

Ludwig Feuerbach[2]

I have discovered the organ of hearing in the common cockroach.

Gottfried Treviranus[3]

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[1] Shakespeare, *The Tempest*, iv. 1.

[2] Ludwig Feuerbach, *Principles of the Philosophy of the Future*, trans. by Manfred Vogel (Hackett, 1986), p. 51.

[3] 'Ich habe an der gemeinen Schabe eine Entdeckung [über das Gehörorgan] gemacht'; Gottfried Treviranus, 'Resultat einiger Untersuchungen über den innern Bau der Insekten', *Annalen der*

The Aural Machine

In 1821, the leading music critic in Vienna, Friedrich August Kanne, reflected on why he valued music so much. What he called 'the magic of music' resided in its capacity to recapitulate and transform melodic figures into ever 'new but analogous forms'.[4] The character of opening figures is pregnant with meaning, we learn, such that perceptive listeners anticipate, even venerate, their latent development as a 'magical means' [*Zaubermittel*]. Decades later, the city's inaugural University Professor of Music, Eduard Hanslick, would likewise write of the 'gratifying reasonableness' found in musical structures that are 'based on certain fundamental laws of nature governing both the human organism and the external manifestations of sound'. These relations (triangulating a network of law–organism–sound) reside 'instinctively in every cultivated ear, which by mere contemplation immediately perceives the organic, rational coherence of a group of tones, or its absurdity and unnaturalness'.[5] For some, this perceptual ability even resided in the mechanism of hearing itself. Arthur Schopenhauer, for one, credited the auditory nerve's 'objective' sentient perception[6] with making musical sounds uniquely suitable for supplying 'the material to express the endless multiplicity and variety of the concepts of [human] reason', no less.[7]

Ostensibly, these paeans to instrumental music merely particularize for sound the principle of ordered magnitudes once prescribed in Aristotle's *Poetics* — between the 'parts' of tragedy. Yet as Kanne's case makes clear, they also answer an intrinsically *human* need, one arising from our mind's 'inner […] purposiveness' and the expectation that art will triumph over arbitrary relationships 'snatched from this life'. This need to order makes us human, he continues, leading us to take joy in recognition and despise randomness:

> *For the human mind wants to order, to form its world, and clarify the miraculous.* That's why compositions that arose from lofty masters' quills have this character of interesting us, and fill the soul with such rare magic. Their great, ravishing power becomes explicable when one thinks that even the simple sound of a melody from *one* instrument has such a wonderful influence on primitive peoples; indeed, even animals can't resist taking part. Whoever has observed the movements of an elephant at the sound of a flute, he will confess that music's influence on animals is of the highest, most marvellous kind. The mighty animal uses the flexibility of his trunk to make known the movement of his inner nature.[8]

Wetterauischen Gesellschaft für die gesammte Naturkunde, 2 (1809), p. 169. All translations are my own unless otherwise specified.

4 F. A. Kanne, 'Der Zauber der Tonkunst', *Allgemeine musikalische Zeitung*, 36 (5 May 1821), p. 282.

5 Eduard Hanslick, *On the Musically Beautiful*, trans. by Geoffrey Payzant (Hackett, 1986), pp. 30–31.

6 That is, without an effect on the will.

7 Schopenhauer, *The World as Will and Representation*, trans. by E. F. J. Payne, 2 vols (Dover, 1969), II, p. 27. By the same mechanism, disordered *noise* actively inhibits 'thinking minds, and people of great intellect generally', because it makes the 'whole mass of the brain tremble and feel the vibrations and oscillations set up by the auditory nerve' (p. 29), as though the seat of our being were also a mechanically hypersensitive jelly.

8 '*Denn der menschliche Geist will ordnen, und seine Welt gestalten, und das wunderbare sich aufklären.* Darum haben Tonwerke, welche aus hochberufener Meisterfeder entsprangen, diesen Charakter des

Does it now? Here the path from human psychology to animal justification is revealing. Kanne cascades the magical effects of varied thematic recurrence down a biological hierarchy, such that the same cognitive effect, discernible in non-European listeners and elephants, marks the music and the hierarchy. In a racialized world view, all this was to be measured by the governing criterion of the human soul [*menschliche Seele*], as seated in the Austrian capital of Leopold II: a stark exemplification of the late Enlightenment liberal subject coupled to the high-water mark of music's putatively most autonomous form in Viennese Classicism.

Under such logic, music shores up the identity of being 'human' as much as human listening authenticates the value of what great music is or should be. Being animal becomes an index for calibrating through sound the higher value of being human. If a dialectic between colonizer and colonized sees the swaying trunk as a feint, or a cognitively muted response to sounds more fully grasped by 'higher' life forms, a human–non-human dialectic hints at the limitation of human listening itself: music affects all 'ears' — an ancient, Orphic power — but unequally. In an age of imbrications between music theory and natural science, this second dialectic offers the more searching logic. Consider Schopenhauer's parallel: he explains a disparity between human and non-human perceptual experience by reference to a theosophy of the four kingdoms: 'The four voices or parts of all harmony […] correspond to the four grades in the series of existences, hence to the mineral, plant, and animal kingdoms, and to man.'[9] Taken literally, this analogy between frequency and world structure relativized humans' place in both. Nineteenth-century listeners become a minor fraction, a dispensable constituent of what musical sound means in the totality of the world.[10] These contrasting logics — colonialist, humanist — are differently framed, admittedly, in their approaches to difference and contingent identities.[11] But in all this we may wonder: if only certain human ears could 'clarify the miraculous' or intuit music's 'rare magic', when did the agents of this construction of human listening become aware of its limitations vis-à-vis non-human ears? Put more provocatively, when did a concept of animal aurality begin to denaturalize the Edenic concert? To ask such a question risks aesthetic blasphemy. It requires us to answer first how an alterity relation with 'other'

Interessanten, und erfüllen die Seele mit so seltenem Zauber. Erklärbar wird die hohe hinreissende Gewalt, wenn man bedenkt, dass schon der einfache Klang einer Melodie aus *einem* Instrumente so wunderbaren Einfluss, auf den Naturmenschen hat, ja, dass sogar die Thiere sich der Theilnahmen nicht erwehren können. Wer einmahl die Bewegungen eines Elephanten beym Klang einer Flöte beobachtet hat, der wird gestehen dass der Einfluss der Musik auf die Thiere sogar von höchst wunderbarer Art ist. Das riesenhafte Thier nimmt die ganze Biegsamkeit seines Rüssels zu Hülfe, um die Bewegungen seines Innern dadurch zu erkennen zu geben'; Kanne, 'Der Zauber der Tonkunst', pp. 283–84.

[9] Schopenhauer, *The World as Will and Representation*, II, p. 447.

[10] Even as music is also, famously, enlisted to act 'directly on the *will*, i.e. the feelings, passion, and emotions of the hearer'; ibid., II, p. 448.

[11] On questions of identity constructions within music studies, see especially Olivia Bloechl and Melanie Lowe's methodological reflections, and their claim that contingencies of identity have potentially vast applicability: 'linguistic […] psychological […] social […] or historical'; 'Introduction: Rethinking Difference', in *Rethinking Difference in Music Scholarship*, ed. by Olivia Bloechl, Melanie Lowe, and Jeffrey Kallberg (Cambridge University Press, 2014), pp. 1–52 (p. 5).

listening bodies initially arose (prior to sound-recording technology).[12] In its most consequential terms, it also raises the prospect that an awareness of non-human listening may have had epistemic consequences, serving to challenge certitudes of human self-identity (ordained exceptionalism via an immortal soul, development of language, mental and moral supremacy) within European centres at the time.[13]

For decades now, humanists have been talking about a crisis in humanistic thought. When John Blacking postulated in 1973 that 'essential physiological and cognitive processes that generate musical composition and performance may even be […] present in almost every human', he pronounced the matter significant 'for the future of humanity'.[14] Yet just five years into that future, the philosopher Stanley Cavell retorted with what seemed an antagonistic question: 'Can a human being be free of human nature?'[15] It tapped into an idea steadily crystallizing within the humanities, that we may unwittingly be slumbering in an 'anthropological sleep', as Michel Foucault had put it in 1966, in which 'the pre-critical analysis of what man is in his essence becomes the analytic of everything that can, in general, be presented to man's experience'.[16] Half a century on and the debate has broken from its humanist logics into discourses of the non-human other, from a transspecies (posthumanist) perspective on music that, for Gary Tomlinson, can reveal 'transspecies capacities that remain to us obscure' and inhere within a 'general dedomestication of our own capacities', to the 'alien listening' postulated by Alexander Rehding and Daniel Chua, and the 'new bioegalitarianism' envisioned by Rosi Braidotti, which proposes that we relate to animals 'as animals ourselves'.[17]

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[12] Cf. Murray Schaffer's 'schizophonia'; *The New Soundscape* (Associated Music, 1969), pp. 43–47.

[13] Representative statements include the Young Hegelian Karl Bayrhoffer: 'Humans are the absolute pinnacle of nature, even in their temporal realization, the final outcome of the idea of life that creates being-for-itself' ['Der Mensch ist die absolute Spitze der Natur, auch in der zeitlichen Verwirklichung das letzte Resultat der sich zum Fürsichsein ausschaffenden Idee des Lebens']; *Beiträge zur Naturphilosophie*, 2 vols (Otto Wigand, 1840), II, p. vii. See also Thomas Reid's articulation of this exceptionalism in *Essays on the Intellectual Powers of the Human Mind* (Bell & Bradfute, 1812). On the empirical side, naturalists such as Ernst von Bibra compared measurements of the brains of humans and animals, observing the primacy of the human brain within a descending ratio of animals, down to amphibia and fish; see *Vergleichende Untersuchungen über das Gehirn des Menschen und der Wirbelthiere* (Bassermann & Mathy, 1854). Modern assertions of an immortal human soul flow through Moses Mendelssohn's Socratic dialogue *Phädon oder über die Unsterblichkeit der Seele* (Friedrich Nicolai, 1767), and among the many nineteenth-century accounts of the role of moral philosophy, *First Principles of Moral Science* (Macmillan, 1873) by Thomas Birks (Knightsbridge Professor of Moral Philosophy at Cambridge) is significant in formulating a concept of 'animal instincts'.

[14] John Blacking, *How Musical is Man?* (University of Washington Press, 1974), p. 7. Cf. Allan Keiler, 'The Origin of Schenker's Thought: How Man is Musical', *Journal of Music Theory*, 33.2 (1989), pp. 273–98.

[15] Stanley Cavell, *The Claim of Reason: Wittgenstein, Skepticism, Morality, and Tragedy* (Oxford University Press, 1979), p. 416.

[16] Michel Foucault, *The Order of Things: An Archaeology of the Human Sciences*, trans. by Alan Sheridan (Random, 1994), p. 341.

[17] Gary Tomlinson, 'Music and Posthumanism', in *The Oxford Handbook of Western Music and Philosophy*, ed. by Tomás McAuley, Nanette Nielsen, Jerrold Levinson, and Ariana Phillips-Hutton (Oxford University Press, 2021), pp. 415–34 (pp. 420–21); Alexander Rehding and Daniel Chua, *Alien Listening: Voyager's Golden Record and Music from Earth* (Princeton University Press, 2021); Rosi Braidotti, 'Animals, Anomalies, and Inorganic Others', *Publications of the Modern Language Association*, 124.2 (2009), pp. 526–32.

With critical spectacles on, then, Kanne's ostensibly appreciative words from 1821 might seem to have aged badly. They can be read as one side of what Giorgio Agamben has called 'the anthropological machine', in which animals are contradistinguished from humans at the cost of certain humans becoming animal. Historically, this is a symmetrical exchange between inside and outside, inclusion and exclusion, that at once dances on the head of a linguistic pin ('man-ape' versus 'ape-man') and yet encompasses the mechanisms by which certain humans have disempowered certain other humans by assigning them to the subhuman category of 'animal', from the European Jew of the 1930s (or 'non-man produced within the man') to the slave or barbarian foreigner ('an animal in human form').[18] Like the posthumanist commentaries with which it resonates, Agamben's 'machine' has chiefly served to reinforce the conception of an indeterminate zone between the categories of human and animal.[19]

Historically speaking, nowhere was this indeterminate zone laid bare more systematically than in the advent of a modern comparative anatomy. For here the categories of animality and humanity were not obviously separable as collections of anatomical data. On this material platform, their long-standing cultural opposition started to become bridgeable, problematically so, leading naturalists such as Johann Friedrich Blumenbach to argue (implausibly) that humans must be distinguished from animals by *hidden* physical workings, just as they were by the hidden workings of the mind and soul.[20] Each claim for shared morphology and function of body matter served as the grappling hooks of so many climber-anatomists dissecting away a taboo of cultural signification, meaning that by 1860 one of Europe's leading anatomists could state: 'physically, man is an animal, undeniably so'.[21] While animal–human commentaries have more recently been linked to questions of identity and difference within postcolonial and posthuman studies, the professionalization of European comparative anatomy can offer a richly documented order of knowledge for histories of listening.[22] In brief, it was

[18] Giorgio Agamben, *The Open: Man and Animal*, trans. by Kevin Attell (Stanford University Press, 2004), p. 37.

[19] Within musicology, Holly Watkins's study of 'aesthetics across species lines' between Herder and Hanslick notably explores the consequences of empathic listening to animal utterances, where 'a formalist approach cannot by itself account for the full biological, affective, and phenomenological significance of animal communication'; *Musical Vitalities: Ventures in a Biotic Aesthetics of Music* (Chicago University Press, 2018), pp. 112–31 (p. 129).

[20] See David Bindman, *Ape to Apollo: Aesthetics and the Idea of Race in the 18th Century* (Reaktion, 2002), p. 194.

[21] 'Körperlich ist er ein Thier, ganz unläugbar'; Karl Ernst von Baer, *Reden* (Schmitzdorf, 1864), p. 29. This represents new officialdom, but hardly a new position. As early as 1745, an anonymous 'Treatise on the Soul', later claimed by arch-materialist Julien Offray de la Mettrie, credited the nascent field of comparative anatomy with revealing the 'perfect resemblance […] between man and beast; for here it is only a question of the similarities between sense organs, which, a few modifications apart, are completely the same and obviously indicate the same uses'; de la Mettrie, *Machine Man and Other Writings*, ed. and trans. by Ann Thompson (Cambridge University Press, 1996), p. 50.

[22] Recent examples include Zakiyyah Jackson, who responds to 'a history of blackness's bestialization and thingification: the process of imagining black people as an empty vessel, a nonbeing, a nothing, an ontological zero, coupled with the violent imposition of colonial myths and racial hierarchy' by arguing that notions of humanity are themselves 'fractured and relational', in *Becoming Human: Matter and Meaning in an Antiblack World* (New York University Press, 2020), pp. 1 and 46;

formalized as a path of study in Paris during 1793, i.e. in the teeth of the French Revolution, the very year Louis XVI and Marie Antoinette were executed, a new constitution proclaimed, and war declared on the British. The Jardin royal des plantes médicinales (Royal Garden of Medicinal Plants) had been transformed into the Muséum d'histoire naturelle (Museum of Natural History) in the course of the Revolution. The Jardin's existing officers had called for the motto *egalité* to be taken seriously within the new institution, resulting in the dismissal of the Intendant and — remarkably by current standards — the conversion of the post into no less than three (later four) new professorships in anatomy. Georges Cuvier (1769–1832) took up the first chair in 'Comparative Anatomy' in October 1802, having renamed his predecessor's chair from simply 'The Anatomy of Animals'.[23] The whole episode hints at the social mechanisms that could elevate an entire profession, underscoring Michel Serres's laconic formulation that 'with the French Revolution, the scientists came to power'.[24]

Prior to this institutional footing, the discipline's historical crux rested on an observation by Carl Linnaeus, the eighteenth-century Swedish zoologist and the first arch-taxonomist of living forms, that 'there is hardly a distinguishing mark which separates man from the apes, save for the fact that the latter have an empty space between their canines and other teeth'.[25] Beyond this false stitch, his ensuing decision to root a 'human' identity not in the faculty of reason or language, in moral character (*prohairesis*), music, or the soul, but more flimsily in mere acts of self-recognition arguably led to a central plank in the modern construct 'human'.[26] In Agamben's paraphrase:

> *Homo sapiens* […] is neither a clearly defined species nor a substance; it is, rather, a machine or device for producing the recognition of the human. […] It is an *optical machine* constructed of a series of mirrors in which man, looking at himself, sees his own image always already deformed in the features of an ape. *Homo* is a constitutively 'anthropomorphous' animal (that is, 'resembling man', according to the term that Linnaeus constantly uses until the tenth edition of his *Systema* [1758]), who must recognize himself in a non-man in order to be human.[27]

Braidotti, for whom 'the animal has ceased to be one of the privileged terms that indexes the European subject's relation to otherness', in 'Animals, Anomalies, and Inorganic Others', p. 526; and, in a sonic context, Anna María Ochoa Gautier, *Aurality: Listening and Knowledge in Nineteenth-Century Colombia* (Duke University Press, 2014).

23 See Andrew Cunningham, *The Anatomist Anatomis'd: An Experimental Discipline in Enlightenment Europe* (Ashgate, 2010), p. 376.

24 Michel Serres, 'Paris 1800', in *A History of Scientific Thought: Elements of a History of Science*, trans. by Dafydd R. Roberts and Ros Schwartz, ed. by Michel Serres and Michel Authier (Blackwell, 1995), p. 422.

25 Carolus Linnaeus, *Menniskans Cousiner*, ed. by Telemak Fredbäri (Ekanäs, 1955), p. 5.

26 Recent philosophical responses include J. M. Coetzee, *The Lives of Animals* (Princeton University Press, 1999); Agamben, *The Open*; and Gerald L. Bruns, *On Ceasing to Be Human* (Stanford University Press, 2011).

27 Agamben, *The Open*, pp. 26–27; emphasis added. See also Stefan Helmreich's account of historical attempts to rename *Homo sapiens*, in *Sounding the Limits of Life* (Princeton University Press, 2016), pp. 62–63.

The machine's visual dimension — recognition, mirrors, optics, looking — seems fitting as signage that enables the *taxonomia* of ordered knowledge. It reflected the medium of print in which readers pored over unfamiliar animal bodies presented in lithographs and etchings (epitomized in the almost two thousand plates of the Comte de Buffon's thirty-six-volume *Histoire naturelle*),[28] and in taxidermy, the 3D spectacle of choice for shop windows, exhibitions, and private homes, arguably turning the preserved animal body into a visual medium for reinforcing European expansion through the narratives it told about other global regions.[29] Yet for Linnaeus, the act of self-recognition was already ironic; for *Homo sapiens* to recognize themselves in non-man 'in order to be human' was a denial of what is physiologically similar as much as an assertion of undefinable difference. Its origin, again, was Aristotelian, for the philosopher's *History of Animals* notably denied a recognizable visage to anything but humans: 'We do not speak of the face of a fish or of an ox.'[30] For our purposes, this also has a traceable *auditory* counterpart in Enlightenment aesthetics, an *aural 'machine'* — adapting Agamben — a series of echoes in which 'man', hearing himself speak or perform, hears his own music already deformed in animal utterances and in projections about their auditory psychology.[31]

It doesn't take long to begin revealing a genealogy of anecdotes that show the aural machine in action. To take two anglophone commentators: half a century after Kanne, the psychologist and pianist Edmund Gurney unquestioningly takes art music as a benchmark when he wonders how a gunshot (the 'coarsest […] most excruciating sound') can be a source of pleasure to culturally refined ears ('or it would not be so constant a feature of modern melodrama'), while, contrariwise, the difference between a beautiful and a 'moderately good' soprano timbre is readily discernible even by the 'East End roughs' of London. His point was that all ears are physiologically equipped to support high and low cultural tastes, regardless of training, class, or colonial baggage: 'Savages […] whose delight in what seem to us hideous noises can in no way be held to

[28] George-Louis Leclerc, Comte de Buffon, *Histoire naturelle, générale et particulière, avec la description du cabinet du roi* (Paris, 1749–89). Birds were illustrated by François-Nicolas Martinet, and quadrupeds by Jacques de Sève. For a critical overview, see John H. Eddy Jr, 'Buffon's Histoire naturelle: History? A Critique of Recent Interpretations', *Isis*, 85.4 (1994), pp. 644–61.

[29] Displays of the unfamiliar also constructed their to-be-looked-at-ness via this medium, fostering a quasi-imperial gaze through the way the eyes of an urban public were now encouraged to participate in 'exploration by proxy'. See Alan S. Ross, 'The Animal Body as Medium: Taxidermy and European Expansion, 1775–1865', *Past and Present*, 249.1 (2020), p. 88.

[30] Aristotle, *History of Animals*, trans. by Richard Cresswell (Bohn, 1862), p. 12.

[31] Ochoa Gautier's critique of Alexander von Humboldt suggests similar deformations occurred when he heard indigenous peoples' utterances during an expedition to Bogotá in 1801: 'If you add all that you can imagine, the tone [of "barbarous, lustful ulalating and angry shouting"] can become a song and even a dialogue'; cited in Ochoa Gautier, *Aurality*, p. 33. Here the deliberate imitation of animal sounds in non-European traditions inverts the operations of Agamben's machine by confusing aesthetic goals with natural origins: 'If sounding like animals, learning sounds from animals, or incorporating nonhuman entities in sound is not a problem but an objective, then it becomes evident that the human–nonhuman relation, or the relation between nature and culture present in the voice is not one that debases the person'; ibid., p. 16.

prove that they are incapable of enjoying what they have never heard.'[32] If we look back half a century before Kanne, the itinerant music historian Charles Burney proposed in 1771 that the very harshest noise is tolerable providing it resolves into concord, and posited that this principle might even supersede a logic of harmony. He tacitly drew on human hearing to rationalize the growing use of non-tonal dissonances he heard among Italian folk musicians. Like Kanne, the argument relies on a singular ear, with its corollary a set of listening techniques trained on an intentional object (the triad), to establish the limits within which the resolution of discords can take place. (Example 1 realizes his illustration: C, D♯, E, F♯, G played simultaneously on the harpsichord, where D♯ and F♯ are released first.) 'The ear must be satisfied at last,' he explains. 'I am convinced, that provided the ear be at length made amends, there are few dissonances too strong for it.'[33] To ask 'which ear?' risks anachronism, and seems unnecessarily disparaging given both writers' observational intelligence within their periods of cosmopolitanism. In each case, a particular kind of human listening defines the value of musical sounds in the context of European modernity, whether according to pattern recognition (Kanne), noise–tone distinctions (Gurney), or dissonance treatment (Burney).

As for the interpretive wrapper of historians reading such sources, Tomlinson has emphasized the nature of functional tonality itself as an 'aural habitus', a supra-individual system based on custom. In its *collective* emergence among listeners of the seventeenth and eighteenth centuries, this becomes an alibi for our three witnesses above: 'beyond the control of individuals, growing and spreading as a network of largely unspoken and partially inarticulable preferences, a social force-field of semi-conscious priorities'.[34] The question arises: why hold historical individuals accountable

Example 1. Charles Burney's example of harmonies, to be played on the harpsichord, that illustrates the human ear's tolerance for harsh dissonance providing it resolves. Burney, *The Present State of Music in France & Italy*, 2nd edn (T. Becket, 1773), pp. 159–60.

[32] Edmund Gurney, *The Power of Sound* (Smith, Elder, 1880; repr. Cambridge University Press, 2012), p. 31.

[33] Charles Burney, *The Present State of Music in France & Italy* (T. Becket, 1771), pp. 152–53; 2nd edn (T. Becket, 1773), pp. 159–60. Cf. Arnold Schoenberg's belief that dissonances, while harder to understand than consonances, are not incomprehensible 'so long as they occur in the right surroundings'; 'New Music: My Music', in *Style and Idea*, trans. by Leo Black (Faber, 1975; repr. University of California Press, 1984), p. 101.

[34] Gary Tomlinson, 'Monumental Musicology', *Journal of the Royal Musical Association*, 132.2 (2007), pp. 349–74 (p. 374). This argument is developed elsewhere: the sense capacity to encode asymmetrical arrangements of discrete pitches within a repeating cycle at a 2:1 ratio (i.e. octaves) 'is far more widespread than some discussions of Western major/minor tonality suggest — perhaps, indeed, almost as ubiquitous as discrete pitch perception itself'; Tomlinson, *A Million Years of Music* (Zone Books, 2015), p. 199.

for ways of listening that are irreducible to individual agency if not to align with the historian's own ideology? What does it mean for these ways of listening to play a positive role in our cultural constitution but for them to be not merely hidden from us (the action of ideology, opposed by critique) but wholly inarticulable? On this count, the pitfall of postulating collective agency for a concept of 'western aurality' is the intrinsic fallibility of those humans equipped to write historical accounts of western music in the first place. Carl Dahlhaus was among the earliest to identify the 'ideal' listener ('sought by historians of reception') as a figment of our historico-analytical presuppositions, reducing it to nothing but the assumed intention behind a composer's text; for Suzanne Cusick three decades later, the 'ideal' listener became a more pernicious counterpart of 'the music itself', that seemingly male-scientific camouflage for 'people with the special training required to interpret meanings that are encoded in patterns of sound' — for both, a convenience of historical method that can only deceive.[35] Either might have had in mind the archetype set out in Heinrich Schenker's early essay on 'Musical Listening' (1894) for the *Neue Revue*, which tasked late nineteenth-century ears with the purest form of ideality. It opens:

> The most perfect perception of a musical work is and remains that which not only takes in its entire tonal material, but also recognizes and tactilely feels out [*durchfühlt*] the compositional laws prevailing in it (unknown or familiar), the destiny of the piece, as it were.[36]

Only the most gifted musicians can achieve this feat by listening, he lamented, reflecting a cynicism not of method (cf. Dahlhaus) or towards human exceptionalism (cf. Tomlinson), but simply towards fellow humans (cf. Agamben).

From 'Our Ear' to '*Some* Ear'

Setting aside such debates, it was precisely the relatability of body physiologies and the assumed constancy of a physics of sound that offered a basis for human–animal comparisons during the early century. Coeval with Kanne, the 22-year-old Italian philosopher and poet Giacomo Leopardi (1798–1837) was also fascinated by the appeal of musical sounds, but approached them from a materialist tradition, i.e. a world view rooted in the primacy of matter. His speculations on animal hearing in his *Zibaldone* sought to rationalize how sounds might be understood to affect different species in the same way. Following some bluff scepticism over Kanne's main point

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35 Carl Dahlhaus, *Foundations of Music History*, trans. by J. B. Robinson (Cambridge University Press, 1983), p. 40; Suzanne G. Cusick, 'Gender, Musicology, and Feminism', in *Rethinking Music*, ed. by Nicholas Cook and Mark Everist (Oxford University Press, 1999), p. 492.

36 'Die vollkommenste Anschauung des musikalischen Kunstwerkes ist und bleibt diejenige, die nicht nur dessen gesammtes Tonmaterial einführt, sondern auch die darin waltenden (fremden oder eigenen) Gesetze des Componisten, gleichsam die Vorsehung des Stückes, erkennt und durchfühlt'; Heinrich Schenker, 'Das Hören in der Musik', *Neue Revue*, 5.2 (1894), pp. 115–21 (p. 115). Schenker puns that feeling out (*durchfühlen*) a work's compositional laws aurally is also a form of performance (*durchführen*).

('You can see how pointless is the absolute conviction that, because music is especially pleasing to human beings, it must have an effect on animals'), he argued that different aural perceptions of the same sound must be a question of degrees of difference, not kind.[37] This left the door open to comparative (interspecies) listening, at least across minimal anatomical differences:

> It is not difficult to suppose that *sounds have some effect on animals*, but it is not necessarily so, or necessarily the same sounds that affect people (we know that among men some nations enjoy sounds that are quite different from ours, and which we would find intolerable). Their organs and, independently of these, their whole way of life are different from ours, and we cannot know what effect this difference has. However, if it is not too great, or if there is at least some affinity with us in this respect, sound will make some impression on such animals.[38]

Biographically, Leopardi was personally attuned to physiological affinities. His lifelong physical discomfort, as a likely sufferer of ankylosing spondylitis (a chronic inflammatory condition that progressively deformed his spine), resulted in 'accentuation or remission of stimuli', his medical notes explain, creating an unusually changeable neural platform for experiencing the world.[39] When he compared animal bodies to humans in this context, physical difference is assumed to be directly proportional to perceptual difference. (Eighteenth-century luminaries such as Johann Gottfried Herder had advocated a similar physiological determinism, but without the frame of materialism.)[40] Even for those with similar bodies, harmonic beauty was 'never absolute'; disagreements between European music theorists arise due to potentially limitless cognitive differences, we learn, and animals too are individuals:

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[37] We might assume Kanne's universalizing gesture prompted such guardedness because it ultimately rests on the Rousseauean idea of music as a 'universal language', a well-intentioned, even beautiful notion that had (nevertheless) permitted the likes of Burney to observe in 1779 that 'a wild kind of music among savages […] can afford no pleasure to a cultivated ear, nor would be honoured in Europe with any better titles than the howlings of animals or an inferior order to mankind'; 'Account of an Infant Musician', *Philosophical Transactions of the Royal Society of London*, 69 (1779), pp. 183–206 (p. 186). As is well known, the impulse to universalize 'music' was skewered decades ago by postcolonial writers such as Homi Bhabha, who persuasively argued that 'universalism […] masks ethnocentric norms, values, and interests'; 'The Third Space', in *Identity, Community, Culture, Difference*, ed. by Jonathan Rutherford (Lawrence & Wishart, 1990), pp. 207–21 (p. 208).

[38] Giacomo Leopardi, *Zibaldone*, trans. by Kathleen Baldwin, ed. by Michael Caesar and Franco D'Intino (Farrar, Straus and Giroux, 2013), p. 123.

[39] 'Nell'accentuazione o remissione segnali'. See comments from his medical record in Erik Pietro Sganzerla, *Malattia e morte di Giacomo Leopardi: Osservazioni critiche e nuova interpretazione diagnostica con documenti inediti* (BookTime, 2016), introduction; and Erik Pietro Sganzerla and Michele Augusto Riva, 'The Disease of the Italian Poet Giacomo Leopardi (1798–1837): A Case of Juvenile Ankylosing Spondylitis in the 19th Century?', *Journal of Clinical Rheumatology*, 23.4 (2017), pp. 223–25.

[40] 'As many modes of sensitivity as are slumbering in our nature, so many tonal modes too. — And thus I note that the less human nature is akin to an animal species, the more the two differ in their nervous structures, the less shall we find the natural language of that animal species comprehensible to us'; Herder, *On the Origins of Language*, trans. by John H. Moran and Alexander Gode (Chicago University Press, 1986), p. 89.

> so even if the abstract idea of harmony could be conceived by animals, it would not follow that their ideas of harmony and beauty would be the same as ours. And so *it is not music as art but its matter, sound, which has an effect on certain animals.*[41]

With this, the phenomenon of animal listening inaugurated a reduced field of study in which only the physical dimension of sound remains.[42] Leaving aside the postulate of 'sonic matter', listener psychology was unquantifiable and unknowable (especially among animals), so any tractable comparison between humans and animals would have to reside in objectively physical causes and effects: sonic vibration on physiological matter.

This new view of listening, as a physical measure of bodies, was wholly in keeping with a mechanical explanation of nature, rooted in an Anglo-French tradition of mechanical philosophers from Isaac Newton and Marin Mersenne to John Robison (1739–1805) and Pierre-Simon Laplace (1749–1827), whose so-called 'demon' famously held that every event is explained by prior events acting upon it: 'We may regard the present state of the universe as the effect of its anterior state and as the cause of the one which is to follow.'[43] Against this absolute causal determinism, human listening was exceptional, but not quite *sui generis.* Its special status was mirrored in debates over teleology (i.e. the study of final causes), for both explained events in relation to human origins rather than the pure mechanics of the universe. For philosophers like Friedrich Lange (1828–75), the problem was epitomized in Socrates' conception of the architect of the world as a person; any form of teleological thinking could only be anthropomorphic because 'the world is explained from man, not man from the universal laws of nature'.[44] The reason that exists in nature is fundamentally human reason, in this sense, just as the music that exists in the world is fundamentally understood only by humans.[45]

If the anthropological identity being projected here was latent, for the emergent disciplines of zoology and comparative anatomy it was explicit. As Bennett Zon has shown, imagery of discrete gradations — steps, ladders, tables — had been used since the early sixteenth century to illustrate the fixed hierarchy of a 'Great Chain of Being', in which lower creatures precede their higher cousins, a view refined in Jean-Baptiste

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41 Leopardi, *Zibaldone*, pp. 123–24; emphasis added.

42 This would also enable the later discourse of a fully physiological aesthetics as a form of applied animal corporeality, from Herbert Spencer's 'aestho-physiology' (where 'feeling and nervous action are the inner and outer faces of the same change') (*Principles of Psychology* (Longman, 1855), p. 1) to Grant Allen's 'physiological aesthetics', the stated purpose of which was precisely to 'elucidate physiologically the nature of our aesthetic feelings' (*Physiological Aesthetics* (S. King, 1877), p. 1).

43 P. S. Laplace, *A Philosophical Essay on Probabilities*, trans. by F. W. Truscott and F. L. Emory, 6th edn (Dover, 1995; orig. *Essai philosophique sur les probabilités*, Coucier, 1814), p. 4. See also Crosbie Smith, '"Mechanical Philosophy" and the Emergence of Physics in Britain', *Annals of Science*, 33.1 (1976), pp. 3–29.

44 Friedrich Albert Lange, *History of Materialism and Criticism of its Present Importance*, trans. by Ernest Chester Thomas, 3 vols (Trübner, 1877–81; orig. *Geschichte des Materialismus und Kritik seiner Bedeutung in der Gegenwart*, J. Baedeker, 1866), I, p. 64.

45 By contrast, the acceptance of mechanism, with its apparatus of cause and effect, was the origin of all post-Newtonian science, and for Lange excludes schemes of teleology ('a partial negation of science') and by implication, music aesthetics. Ibid., p. 21; translation adapted.

Lamarck's 1809 theory of progressive *transformisme*, the 'transmutation' of species from lesser to greater biological complexity, where a cumulative inheritance of acquired characteristics drives the alteration of one species into another (prior to Darwin's theory of natural selection in 1859).[46] For musically inclined Victorians, the differing capacity of animals to make 'music' is the animating fantasy of this discourse; its formulations have been well documented by scholars like Zon, who traces those theological naturalists inclined to assign birds an animal soul corresponding to their relative musical abilities, and like Rachel Mundy, whose critique of how cultural categories are assigned indicates that theories of musical evolution often covertly became 'a means to debate the right to personhood', with song itself 'a measure of other species' worth'.[47]

But this is not an article about animal *music*; it is about an awareness of non-human listening among European commentators. Since the mid-eighteenth century, the Chain's hierarchy was faithfully reflected in the progressively limited auditory abilities naturalists ascribed to animals. This extended from the Scottish surgeon John Hunter's (1728–93) thoughts on hearing in fish, as 'a link in the chain of the varieties in this sense in different animals, in which there is a regular progression, viz from the most perfect animals down to the most imperfect', to the Harvard zoologist Louis Agassiz's (1807–73) later pronouncements on the entire kingdom, where hearing mechanisms are 'more and more simplified, as we descend the series'.[48] In a sense, the discussion below tracks the breaking down of this way of thinking during the mid-nineteenth century. It traces the processes of discovering and reflecting on new understandings of how anatomical and physiological differences between species were thought to determine perceptual difference. Above all, it asks: when did the penny drop that human hearing was neither the only aural reality nor necessarily the 'highest' or truest in the natural world?

For the biologist Thomas Huxley (1825–95) in 1863, this was '*the* question of questions for mankind', namely 'the ascertainment of the place which Man occupies in nature and of his relations to the universe of things. Whence our race has come; what are the limits of our power over nature, and of nature's power over us.'[49] A shifting perspective is already evident in British definitions of music in the wake of evolutionary theory. Charles Darwin, who derived 'intense pleasure' from music but once confessed 'I am so destitute of an ear, that I cannot perceive a discord or keep time', would argue in *The Descent of Man* (1871) that, in principle, *any* ear able to discriminate between

[46] Bennett Zon, *Evolution and Musical Culture* (Cambridge University Press, 2017), pp. 20–35. Cf. Lamarck, *Philosophie zoologique* (Chez Dentu, 1809).

[47] Zon, *Evolution and Musical Culture*, pp. 62–63; Rachel Mundy, *Animal Musicalities* (Wesleyan University Press, 2018), pp. 11 and 19.

[48] John Hunter, 'Account of the Organ of Hearing in Fish', *Philosophical Transactions of the Royal Society*, 72 (1 January 1782), pp. 379–83 (p. 380); Louis Agassiz and A. A. Gould, *Outlines of Comparative Physiology: Touching the Structure and Development* (Bohn, 1851), p. 76.

[49] Thomas Huxley, *Evidence as to Man's Place in Nature* (Williams & Norgate, 1863), p. 71; emphasis added.

multiple sounds is one that is also sensitive to musical notes.[50] The capacities are two sides of the same coin, in other words. By the end of the century, the English musicologist W. J. Treutler appeared to bridge the positions above in a kind of interspecies aesthetics, telling the Musical Association in London that

> for our purpose we may define *music* as a succession of sounds so combined and modulated as to please, not only *the* ear — our ear — but *some* ear; that is the fundamental idea — the object of music is the gratification of the sense of hearing.[51]

A consequence of this zoological episteme was that the emergent scene of a professional comparative anatomy afforded musicians and scientists a basis on which to understand their auditory environment as quantifiably distinguishable from that of animals, and that in turn afforded critical distance from their own auditory environment for the first time. Here we are faced with a slow process of self-alienation by which certain human listeners, encountering a concept of animal aurality, became newly distanced from their own 'musical' auralities, making it possible to stir, if not quite awaken, from their anthropological sleep.

In what follows I argue that this process of aural self-alienation can be attributed in large part to a new order of physiological self-knowledge emerging from comparative anatomy. That is, physiological properties of the human subject became important aesthetic, philosophical, and critical questions thanks to thinkers like Ludwig Feuerbach and Karl Marx, thereby establishing the conditions for the idea that animals with physical organs and their own physiologies were also to be implicated in those same aesthetic, philosophical, and critical questions. As we shall see, this comparative logic bears witness to the aural machine's role in establishing an 'indeterminate zone' between the categories of human / animal listening.

Feuerbach's Anthropological Materialism: 'I […] Make the Ear Divine'

Hitherto, the bodies registering sound stimuli we have been tracing are all human. Historically, this bias becomes explicable when we consider that it was Feuerbach's *Critique of Hegelian Philosophy* (1839) and his subsequent *Principles of the Philosophy of the Future* (1843) that first broke with Hegel to establish a widespread philosophical materialism rooted in human perception, exerting 'a powerful and immediate influence' in the literary centres of the German Federation.[52] Intellectual historians have long acknowledged that his impact on European thinkers such as Marx or Ludwig

[50] Charles Darwin, *Evolutionary Writings*, ed. by James A. Secord (Oxford University Press, 2008), p. 378. For an overview of Darwin's scattered reflections on music, see Miriam Piilonen, *Theorizing Music Evolution: Darwin, Spencer and the Limits of the Human* (Oxford University Press, 2024), pp. 31–43.

[51] W. J. Treutler, 'Music in Relation to Man and Animals', *Proceedings of the Musical Association*, 25 (1898), p. 72, doi:10.1093/jrma/25.1.71.

[52] Warren Breckmann, 'The Young Hegelians: Philosophy as Critical Praxis', in *The Cambridge History of Modern European Thought*, ed. by Warren Breckmann and Peter E. Gordon (Cambridge University Press, 2019), pp. 88–110 (p. 103). Regarding Feuerbach's influence on Marx, see Hans-Martin Sass, 'The "Transition" from Feuerbach to Marx: A Re-interpretation', *Studies in*

Büchner was profound, for he established a relation between philosophical theory and human activity, experience, and culture, thereby 'turn[ing] philosophy first into a critique of philosophy itself', in Mark Wartofsky's paraphrase.[53] Less appreciated in this epistemic move is the amplified role it created for humankind. 'The new philosophy', Feuerbach asserts in *Principles*, 'makes *man, including nature* (as the basis of man) the *sole, universal* and highest object of philosophy, that is, *anthropology including physiology* becomes the *universal science*.'[54] As is well known, his outlook was conceived as a release from captivity, his writings a coiled spring finally loosed from the caged abstractions of Hegel's Berlin lecture theatre. He remonstrated against a dualist world view whose mental side had been sustained by an immaterial God and the 'logico-metaphysical shadows' of idealism, in which the essence of God and that of speculative thought are held to be synonymous:[55] 'God is pure spirit, pure essence, and pure action […] without […] sensation, or matter. Speculative philosophy *is* this pure spirit and pure activity realized as an act of thought — the absolute being as absolute thought.'[56] To renounce immaterial speculation meant embracing a cluster of concepts newly revised as modern: scientific approaches to tactile, anatomical flesh; human bodies' relation to the environment; and the agency behind mechanical acts of perception. 'What is light […] without the eye? It is nothing', Feuerbach observes. 'Only the consciousness of seeing is the reality of seeing or real seeing.'[57] Epistemologically, this proto-ecological outlook represented a profound turn away from systematic idealism. In contrast to a metaphysical theology that regarded God as a 'pure object of the mind', it was modern man who now occupied the rhetorical centre ground, chiefly as an object (and agent) of sensory apparatus, whose field of comprehension, as well as his immediate reality, was defined by the perceptual acts he was able to accomplish.[58]

Soviet Thought, 26 (1983), pp. 123–42, doi:10.1007/BF00831762; and Frederick Gregory, *Scientific Materialism in Nineteenth-Century Germany* (Riedel, 1977), pp. 13–28.

53 Mark W. Wartofsky, *Feuerbach* (Cambridge University Press, 1977), p. 18. He paraphrases Feuerbach's own remark that 'true philosophy is the negation of philosophy; it is really *no* philosophy at all' ('Die wahre Philosophie ist die Negation der Philosophie, ist *keine* Philosophie'; 'Vorwort', *Sämtliche Werke*, 10 vols (Wigand, 1846), I, p. ix (hereafter *SW*)).

54 Feuerbach, *Principles of the Philosophy of the Future*, p. 70 (orig. 'Grundsätze der Philosophie der Zukunft', *SW*, II, pp. 269–346). Earlier philosophical pronouncements on human particularity include Novalis's claim that 'there is but one temple in the world, and that is the body of man. […] We touch Heaven when we lay our hand on a human body' ('Es gibt nur Einen Tempel in der Welt und das ist der menschliche Körper. […] Man berührt den Himmel, wenn man einen Menschenleib betastet'; *Novalis Werke*, ed. by Gerhard Schulz, 3rd edn (Beck, 1987), p. 530). See also Schelling's abstraction of humankind from history: 'Man must be granted an essence outside and above the world […] Because [his] essence holds time enveloped, it serves as a link that enables man to make an immediate connection with the most ancient past as well as the most distant future'; see Slavoj Žižek and Friedrich Schelling, *The Abyss of Freedom: Ages of the World* (Michigan University Press, 1997), p. 114.

55 Feuerbach, *Principles of the Philosophy of the Future*, p. 66.

56 Ibid., p. 10.

57 Ibid., p. 27.

58 Ibid., p. 32.

Once born, this ostensibly liberating idea was immediately vulnerable to co-option in divergent directions. (Its appropriation by different actors reflects individuals' mistrust or confidence in their sentient kin, exemplifying the reflexive principle that accounts of encroachment between animal and human categories convey as much about how the narrators view their own humanity as they do about their attitudes and relations to non-human animals.)[59] To start with the negative side, it would become twisted in Arthur de Gobineau's biological world view as a means of contradistinguishing races in his *Essai sur l'inégalité des races humaines* of 1853–55:

> I have shown the unique place in the organic world occupied by the human species, the profound physical […] differences separating it from all other kinds of living creatures. […] The immense superiority of the white peoples in the whole field of the intellect is balanced by an inferiority in the intensity of their sensations. In the world of the senses, the white man is far less gifted […] so is less tempted and less absorbed by considerations of the body.[60]

It is indicative of the frailty of such a baseless supposition that it would be precisely inverted by fellow racial theorist Francis Galton in 1883: 'A delicate power of sense discrimination is an attribute of a high race.'[61] On the more positive side, the physicist and philosopher Ernst Mach would write in 1866 of humans' innate capacity to train sense acuity by attention, practice, and habitual activity within an environment: 'The sense acuity of Indians, instructed on nothing but natural objects, has already become proverbial.'[62] His 'well-practised ear' (*das wohlgeübte Ohr*, an unapologetic riff on the *Well-Tempered Clavier*) advocated the benefits of aural training inspired by this idea; even simple experiments in dyadic intervals and harmonic progressions show that 'the same sentient object can give rise to quite different perceptual experiences',[63] and since his purpose was pedagogical, he proceeds to make the obvious point:

> The ear is able to fix individual sounds just as the eye orientates itself by particular points. […] Not everyone knows how to follow a symphony in its individual voices. The musician must learn to listen, as the painter learns to see.[64]

Beyond the historical orbit of Mach's 'physical music theory' (*physikalische Musiktheorie*), even a brief look forwards at the correspondence with Steven Feld's celebrated call for an acoustic epistemology, or *acoustemology* (that echoes 'how sounding and the

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[59] Tim Ingold ties this to histories of animal domestication; 'From Trust to Domination: An Alternative History of Human–Animal Relations', in *Animals and Human Society: Changing Perspectives*, ed. by Aubrey Manning and James Sperlell (Routledge, 1994), pp. 1–22.

[60] Arthur de Gobineau, *The Inequality of Human Races*, trans. by Adrian Collins (William Heinemann, 1915; orig. *Essai sur l'inégalité des races humaines*, Firmin Didot, 1853–55), p. 205.

[61] Francis Galton, *Inquiries into Human Faculty and its Development* (Macmillan, 1883), p. 33.

[62] 'Die Feinheit der Sinne des Indianers, der eben ganz auf die Natur angeweisen ist, ist bereits sprichwörtlich geworden'; Mach, *Einleitung in die Helmholtz'sche Musiktheorie* (Leuschner & Lubensky, 1866), p. 20.

[63] 'Dasselbe sinnlich Object kann durch ihr Zuthun allein zu ganz veschiedenen Wahrnehmungen Veranlassung geben'; ibid., p. 21.

[64] 'Das Ohr vermag einzelne Klänge zu fixieren, wie das Auge sich nach bestimmten Punkten richten. […] Nicht Jedermann versteht es, eine Symphnonie in ihren einzelnen Stimmen zu verfolgen. Der Musiker muss hören lernen, wie der Maler sehen lernt'; ibid., p. 22.

sensual, bodily, experiencing of sounds is a special kind of knowing, or put differently how sonic sensibility is basic to experiential truth'), indicates that a human-universalizing impulse remained embedded within the ethnomusicological toolkit of the 1990s (here regarding the Kaluli people).[65] Feld has since opened up the concept as a broader relational ontology, applicable to interspecies and posthuman logics — 'life is shared with others-in-relation'[66] — but this extendibility only underscores that the sustained anchor of Feuerbach's anthropo-physiology bears historical consideration across potentially wider periods and disciplinary grooves than its reception suggests.

As an avowed monist, Feuerbach's broader aim was to bridge the Cartesian divide by positing humans as nothing less than 'the living superlative of *sensualism*, the most sensual and sensitive being in the world'.[67] This impulse aligned his writings with the ongoing achievements of the natural sciences in understanding knowledge through the mechanics of sensation. Human aurality was implicated from the outset. As though responding to Feuerbach, Richard Pohl's introduction to his eight *Akustische Briefe* (1852–53), serialized in the *Neue Zeitschrift für Musik*, positioned the link between sentient mechanism and mind as critical for understanding modern aesthetics. He recapitulated Kanne's point about pattern recognition, that the human mind instinctively 'searches for the *law* to which [similar phenomena] are all subject', and had no qualms about recognizing that the entire world of appearances rests on the 'unmovable basis of general *mechanical principles*',[68] continuing:

> If we claim that the arts, as a product and excursion of the human mind, stimulated by sense impressions, calculated on sense impressions, and using the means that material nature offers us to do so — that the arts must ultimately also be included in this cycle of cause and effect, in this law-governed context of natural phenomena — is this claim not still met with dissent from all sides? No matter; the ultimate purpose of these letters is precisely to demonstrate the *necessity* of a law-governed connection between natural phenomena and mental activity in relation to *music*.[69]

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65 Steven Feld, 'From Ethnomusicology to Echo-Muse-Ecology', *The Soundscape Newsletter*, 8 (1994) <https://www.stevenfeld.net/s/1993-From-Ethnomusicology-to.pdf> [accessed 19 July 2025].

66 Steven Feld, 'On Post-Ethnomusicology Alternatives: Acoustemology', in *Perspectives on a 21st-Century Comparative Musicology*, ed. by Francesco Giannattasio and Giovanni Giuriati (Nota, 2017), pp. 82–100 (p. 87).

67 'Der Mensch unterscheidet nur dadurch von den Thieren, daß er der lebendige Superlativ des Sensualismus, das allersinnlichste und allerempfindlichste Wesen von der Welt ist'; Feuerbach, 'Wider den Dualismus von Leib und Seele, Fleisch und Geist', *SW*, II, p. 371; emphasis added.

68 'Der Menschengeist […] prüft die einzelne Erscheinung und forscht nach *Verwandtem.* Eine Mannigfaltigkeit ähnlicher Erscheinungen faßt er zusammen und sucht nach dem *Gesetz*, dem sie gemeinsam unterworten sind'; 'Auf der unerschütterlichen Basis der allgemeinen *mechanischen Grundprincipien* ruht die gesammte Erscheinungswelt'; Richard Pohl, *Akustische Briefe* (Hinze, 1853), pp. 2 and ix.

69 'Wenn wir behaupten, daß die Künste, als Erzeugniß und Ausflug des Menschengeistes, durch Sinneseindrücke angeregt, auf Sinneseindrücke berechnet, und der Mittel, welche die materielle Natur uns bietet, sich dazu bedienend — daß die Künste zuletzt gleichfalls in diesen Cyclus von Ursache und Wirkung, in diesen gesetzlichen Zusammenhang der Naturerscheinungen folgerecht eingereiht werden müssen — wird diese Behauptung noch jetzt nicht allenthalben Widerspruch erfahren? Dennoch ist der letzte Zweck dieser Briefe gerade der, die *Nothwendigkeit* eines gesetzlichen Zusammenhanges zwischen Naturerscheinung und Geistesthätigkeits in Bezug auf die *Musik* […] darzulegen'; ibid., p. 6.

Writing in Feuerbach's shadow, Pohl explicitly linked this musical turn to a schism in human identity; mechanism might explain sentient perception, even cognitive activity (for materialists), but *Geist* alone explains artistic creativity. In moments of creativity, we see and feel 'the artistic achievements of divine, Promethean sparks in humans, there where something comes into being from the apparent void and the "animation" of matter begins — there calculation and explanation stop — *there we feel that we are human*'.[70] That is, not animal, whose status as *bête-machine* had been stable since Descartes. The creative agency that, for Pohl, was still irreducible to Hegelian *Geist* (and correspondingly nostalgic), for Feuerbach was expressed differently: as human consciousness. They were parallel but not synonymous. Far from a retreat into idealism's abstractions, this built on Feuerbach's view that human sensing was never merely the product of mechanical causality. It always went hand in glove with mental agency: 'thinking as such is present and active in all the activities of our senses', he asserts in 1835, where sensation, correspondingly, is understood as 'reason identical with our unmediated, individual senses, or *personal sensate* reason'.[71] Mentally alert listening thus constituted a force of consciousness enabled by one's physiological condition, whether in contemplating the thematic permutations of a keyboard sonata or in the abstract task of perceiving objects 'as differentiated from ourselves'.[72] What Pohl's critique reveals is that Feuerbach was only one among a number of 'individual voices […] forging energetically forwards' in pursuit of an uneasy integration of physical causality and music aesthetics.[73]

Away from music, Feuerbach's prestige — and notoriety — for tarnishing Hegel, his erstwhile teacher in Berlin, was famously immediate: 'We all became at once Feuerbachians', Friedrich Engels recalled of his intellectual patricide.[74] That his ideas immediately spilled over into the political sphere underscores their attractiveness in *Nachmärz* circles beyond theology and aesthetics. Already in 1845, Marx and Engels would write of 'the real individuals, their activity and the material conditions under which they live' as first premises for their newly minted materialist conception of history. With historical distance, this now reads as a first shoot growing from the strengthening tree of Feuerbach's anthropo-physiology:

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70 '[Wir sehen und fühlen] das künstlerische Schaffen des göttlichen Prometheusfunkens im Menschen […] da, wo aus dem scheinbaren Nichts ein Etwas wird und die "Begeisterung" der Materie beginnt: da hört Berechnung und Erklärung auf — da fühlen wir, daß wir Menschen sind'; ibid., p. 7.

71 'Die Empfindung ist nichts andres, als die mit unserm unmittelbaren, individuellen Sein identische Vernunft, die *persönliche* und *sinnliche* Vernunft'; in Feuerbach, 'Kritik des "Antihegel"', *SW*, II, p. 62.

72 Ibid. It is against this backdrop of psychophysiological determinism that Theodor W. Adorno could later argue that comparing humans to insects in a musical context (here, 'jitterbugs') points to mindlessness, i.e. 'the recognition that [humans] have been deprived of autonomous will' rather than fast-moving 'jittering bugs'; Theodor W. Adorno, 'On Popular Music', *Essays on Music*, trans. by Susan H. Gillespie (University of California Press, 2002), p. 465.

73 'Einzelne Stimmen […] dringen energisch vorwärts'; Pohl, *Akustische Briefe*, p. 4

74 Friedrich Engels, 'Ludwig Feuerbach and the Outcome of Classical German Philosophy' in Karl Marx and Friedrich Engels, *Collected Works*, 50 vols (Lawrence and Wishart, 1975–2004), XXVI, pp. 353–89 (p. 364); translation modified.

> The first premise of all human history is, of course, the existence of living human individuals. Thus the first fact to be established is the *physical organisation of these individuals and their consequent relation to the rest of nature* […] Men can be distinguished from animals by consciousness, by religion or anything else you like. They themselves begin to distinguish themselves from animals as soon as they begin to produce their means of subsistence, a step which is conditioned by their physical organisation. By producing their means of subsistence men are indirectly producing their actual material life.[75]

Consider the reactionary chain that preceded this centring of 'material life'. If Hegel's *Aesthetics* had foretold the 'end of art' in the early 1820s, predicting a chilling segue from artistic creativity to 'intellectual consideration […] knowing *philosophically* what art is', Marx's doctrine of historical materialism, connecting historical change to productive forces, presided over the '*end of philosophy*' itself in 1845.[76] While his historical materialism separates from a strictly philosophical materialism thereafter, their common root in human physiology — an 'anthropological materialism', as Alfred Schmidt memorably put it — is clear.[77]

Marx acknowledged as much. He maintained that human sense acuity has both been shaped by and has shaped our social and civic developments ('a musical ear, an eye for beauty of form — in short, *senses* capable of human gratification […] the *forming* of the five senses is a labour of the entire history of the world down to the present'), marking them out, on the grandest of terms, as a newly burnished index for an undocumented human past.[78] This was one reason why Foucault regarded Marx as the first epistemological mutation of modern history.[79] Rather than being just a physiological trace of societal toil, the human senses, in Marx's bio-historical construct, now presented the possibility of a dialectic between identity and acuity that laid claim to what was perceptually and psychologically 'real', no less, for individuals:

> Man's *human* relations to the world — seeing, hearing, smelling, tasting, feeling, thinking, observing, experiencing, wanting, acting, loving — in short, all the organs of his individual being […] are in their *objective* orientation, or in the *orientation to the object*, the appropriation of the object, the appropriation of *human* reality.[80]

Logically, this appropriated reality was deterministic and hence infinitely changeable (*in nuce*: different acuities create different realities), for the proposed capacity of 'organs' to determine or manipulate one perceptual reality presupposes the existence

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75 Karl Marx and Friedrich Engels, 'The German Ideology' (1845–46), *Collected Works*, v, p. 31; emphasis added.

76 Hegel, *Aesthetics: Lectures on Fine Art*, 2 vols, trans. by T. M. Knox (Clarendon, 1975), I, p. 11.

77 Alfred Schmidt, *Anthropologischer Materialismus*, ed. by Schmidt, 2 vols (Europa, 1967), I, pp. 5–67.

78 Karl Marx, *Economic and Philosophic Manuscripts of 1844*, trans. by Martin Milligan (Foreign Language Publishing House, 1961; repr. Dover, 2007), p. 108.

79 Michel Foucault, *Archaeology of Knowledge*, trans. by A. M. Sheridan Smith (Routledge, 1989), pp. 12–13. Its musical consequences have long since returned the discourse to aesthetics, e.g. in Marxist approaches to music history which permitted the East German historian Georg Knepler to claim in 1977 that 'the history of material production cannot be written without considering the history of art. […] When you do music history you are doing human history, whether you know it or not'; *Geschichte als Weg zum Musikverständnis: Zur Theorie, Methode und Geschichte der Musikgeschichtsschreibung* (Reclam, 1977), pp. 347 and 544.

80 Marx, *Economic and Philosophic Manuscripts*, p. 106.

of others, an insight prescient of writings about diverse animal sentience in the ensuing decades. Thus what was initially envisaged (by Kanne, Feuerbach, et al.) as a singular perceptual reality for humans carried a latent pluralism from the outset. Critically, this remained fixed for individuals in the absence of physical change. Marx rejected the idea that the limitations of consciousness are removed simply by seeking to swap one kind of conscious perception for another, in effect by thinking oneself into another reality: 'This demand to change consciousness amounts to a demand to interpret reality in another way, i.e. to recognize it by means of another interpretation.'[81] The sentient grounding of German philosophy *c.* 1845 was never subject to abstract volition, in other words, which made it all the more appealing as an object of study vis-à-vis Darwinism, as Marx later acknowledged in *Das Kapital* (1867).[82]

Ears did not escape this epistemic change. The episteme being inaugurated here makes the turn from (divine) abstractions to (human) sense immediacy (Feuerbach's 'humanization of God')[83] pivotal for those contemporary writers who understood music as a sensate, intentional object, permitting Feuerbach, in an aside, to note without profanity: 'If I make the tone divine, I also make the ear divine.'[84] The terms of this divine ear were 'limitless' vis-à-vis animals, as we shall see, for its status was inherited from an unseated God, chronologically and epistemologically, so it retained a double trace of man's theological origins in Derrida's sense of a 'simulacrum of presence that […] refers beyond itself', i.e. where the trace of godliness can simulate a presence in human aurality without *being* a presence.[85] Yet it was also now explicitly the object of a concretizing sensory outlook.[86] What this paradox meant for musical readers of Feuerbach, from Richard Wagner to Felix Mendelssohn, Pohl to Franz Brendel, is that a human outlook remained an essential framework in these debates, and — correspondingly — human listening was sovereign.[87]

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81 Marx and Engels, 'The German Ideology', p. 30. To be sure, Marx was quick to distinguish this outlook from Feuerbach's 'inconsistent' materialism (which, he felt, failed to connect the sentient world to the actions of human industry and society by positing it as 'a thing given direct from all eternity'); ibid., p. 39.

82 Marx compares the history of eighteenth-century technology to that of the body, unveiled in Darwin's theory of biological evolution, figured as the 'history of nature's technology': 'Does not the history of the productive organs of humanity, of organs that are the material basis of all social organisation, deserve equal attention?'; *Capital*, Marx and Engels, *Collected Works*, xxxv, p. 375 n. 2.

83 Feuerbach, *Principles of the Philosophy of the Future*, p. 5.

84 Ibid., p. 26.

85 Jacques Derrida, *Speech and Phenomena, and Other Essays on Husserl's Theory of Signs*, trans. by David Allison (Northwestern University Press, 1973), p. 156.

86 For Mark Burford, the adage 'homo homini Deus est' ('man is the God of man') translated specifically into the natural sciences' disclosure of 'humankind's own ability to access the hidden secrets of the phenomenal world'; 'Hanslick's Idealist Materialism', *19th-Century Music*, 30.2 (2006), p. 169, doi:10.1525/NCM.2006.30.2.166.

87 Mendelssohn briefly overlapped with Feuerbach at Berlin University: Feuerbach matriculated in philosophy at Berlin University in 1824, Mendelssohn in 1827, in which year Feuerbach transferred to Erlangen University to read natural science; Larry Todd, *Mendelssohn: A Life in Music* (Oxford University Press, 2003), p. 171. On Wagner's relation, see David Trippett, *Wagner's Melodies* (Cambridge University Press, 2013), pp. 283–85. On Pohl's and Brendel's proximity to Feuerbachian materialism, see the articles by philosophers and scientists in volume 2 of their journal *Anregungen für Kunst, Leben, und Wissenschaft* (1857).

Animal Sentience: 'A Mystery Impenetrable to our Intellect'

If Feuerbach's writings had made the categories of God and 'man' continuous, the agents of comparative anatomy achieved the same for the categories of human and animal. Archeologically, this parallel exchange bears some consideration, for each are moments of theoretical transformation that established a new perspective. But where did they connect? In 1878, the English psychologist and Helmholtz student James Sully (1842–1923) drew out the implications for music: 'The facts of comparative anatomy would seem […] to support the hypothesis that sensibility to musical tone extends through a much larger number of species than those known to be musical.'[88] Helmholtz himself was doubtful, and joked in private correspondence about an ongoing zoological obsession among his physiologist colleagues.[89] Yet given the widespread consensus after *Sensations of Tone* (1863) that pitch and melodic relationships are sensible via the mechanically predictable behaviour of the organ of Corti, mammals with developed cochleae were by anatomical class endowed with the 'physiological basis of musical sensibility', according to Sully, while reptiles and amphibia, having no less rudimentary cochleae than birds, must by similar logic be possessed of only 'a latent sensibility to tones and melody'.[90]

Paradoxically, naive deductions of this sort drew authority from the cutting edge of empirical knowledge. Sully argued that since avian and human ears obeyed the same physiological principles, avian melodies too were explicable by Helmholtz's recently minted 'affinity theory', a principle for determining pleasing melodic intervals based on the presence of at least one common overtone between adjacent pitches:

> The harmonic affinities of notes are clearly perceived and selected by most singing birds. Thus among the commonest intervals are the fifth and fourth, both of which are marked by the presence of a common partial tone.[91]

Sully had studied with Helmholtz in Berlin during 1871–72, and proudly noted their attendance of Wagner operas together.[92] Beyond a master–pupil influence, his ready attribution to birds of a physiological music theory laid bare the relatable forms between living bodies now viewed as material assemblages (and inviting casually inductive comparisons such as 'primitive human melody was probably inferior to that of many [modern] birds').[93] It was a levelling gesture between *all* organic bodies, in other words, that played into a 'presumptuous priority' of psychophysiology over

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88 James Sully, 'Animal Music', *The Cornhill Magazine*, 40 (1879), p. 614.

89 He complained in 1849 that the only 'productive mind' on the Königsberg medical faculty, Martin Tathke, was 'consumed by zoological interests'; Helmholtz to du Bois-Reymond, 14 October 1849. In 1852, Helmholtz quipped of his influential teacher of physiology, 'Müller is presumably fishing for *Synapta* in Trieste'; Helmholtz to du Bois-Reymond, 24 March 1852. In *Dokumente einer Freundschaft: Briefwechsel zwischen Hermann von Helmholtz und Emil du Bois-Reymond 1846–1894*, ed. by Christa Kirsten (Akademie, 1986), pp. 86 and 128.

90 Sully, 'Animal Music', p. 614.

91 Ibid., p. 610. See Helmholtz, *Sensations of Tone*, trans. by Alexander Ellis (Dover, 1954; orig. *Die Lehre von den Tonempfindungen*, Friedrich Vieweg und Sohn, 1863), p. 256.

92 Sully, *My Life and Friends*, p. 142.

93 Sully, 'Animal Music', p. 619.

history that Benjamin Steege has identified as a hallmark of Helmholtz's early reception.[94]

Behind Sully's claim for mental faculties was arguably a deeper presumption concerning sensationalism, i.e. the long-standing belief that all knowledge originates with sense stimuli, which was now cautiously being extended to animals. Since the early seventeenth century, the Anglo-French doctrine of sensationalist psychology had held that all ideas or thoughts were less-perfect copies of immediate physical sensations. In this context, anatomists from Erasmus Darwin (1731–1802) to the Gallic triumvirate of Pierre Cabanis (1757–1809), Lamarck (1744–1829), and Cuvier shared a common theoretical inheritance in which the sensationalist interpretation of ideas meant the mechanism of animal cognition was similar to human cognition: 'thus no insuperable metaphysical or psychological barriers separated men from animals', as Robert J. Richards summarized.[95] Human acts of knowing, including — at a push — listening to melodic figures in Vienna or folk harmonies in Naples, drew on precisely the same resources as animals, in such a view, even while no anatomist could deny that sense acuity in animal bodies was determined in ways particular to their anatomy.

Historically, the underlying discourse was Aristotelian (*De sensu*), and even before John Locke's canonical formulation of it in 1689,[96] it was frequently transmitted by scholastic thinkers through the Latin catchphrase 'Nihil est in intellectu quod non prius fuerit in sensu' ['there is nothing in the intellect that did not first originate in the senses']: from Thomas Aquinas's *De veritate* (1256–59), where it concerned the gradual transfer of 'things' from their own 'material conditions to the immateriality of the intellect, by means of the immateriality of the senses', to Valascus de Tarenta's *Philonium* (1418), where it emerged specifically in the context of deafness.[97] By the later nineteenth century, anatomically schooled materialists took up this notion (and this phrase) with almost undignified alacrity, as though its heritage were a vindication of their outlook.[98] Yet as the case of Erasmus Darwin shows, mere belief in sensationalism didn't lead to greater knowledge of animal sentience. His tract on 'the essential properties of bodies', *Zoonomia* (1794), is an example of a foundational text that emanates from this sensationalist tradition yet fails to draw any conclusions about

[94] Benjamin Steege, 'Helmholtz, Music Theory, and Liberal-Progressive History', *Journal of Music Theory*, 54.2 (2010), pp. 283–310 (p. 308), doi:10.1215/00222909-1214939.

[95] Robert J. Richards, 'The Emergence of Evolutionary Biology of Behaviour in the Early Nineteenth Century', *British Journal for the History of Science*, 15.3 (1982), pp. 247–80 (p. 257), doi:10.1017/S0007087400019348.

[96] 'There appear not to be any ideas in the mind before the senses have conveyed any in'; Locke, *Essay Concerning Human Understanding*, 4 vols (Elizabeth Holt for Thomas Basset, 1689; ed. by Roger Woolhouse, Penguin, 2004), §23.

[97] 'Gradatim enim res a sua materialitate ad immaterialitatem intellectus deducitur, scilicet mediante immaterialitate sensus'; Thomas Aquinus, *Quaestiones disputatae de veritate*, Q. 2, Art. 3, p. 19; trans. by Robert Mulligam <https://isidore.co/aquinas/QDdeVer2.htm> [accessed 19 July 2025]. A brief genealogy of the cited Latin phrase is given in Paul Cranefield, 'On the Origin of the Phrase *Nihil est in intellectu quod non prius fuerit in sensu*', *Journal of the History of Medicine and Allied Sciences*, 25 (1970), pp. 77–80.

[98] A notable case is Ludwig Büchner, *Force and Matter*, trans. by Frederick Collingwood (Trübner, 1864; orig. *Kraft und Stoff*, Meidinger Sohn, 1855), p. 157.

sensory acts of knowing, leaving unmet the challenges of how to establish the limits of animal sense or the threshold between sense and signification — what would later become the field of biosemiotics.[99] He simply rooted both in the sensorium, defined as a watery 'spirit of animation' (a fluid substance flowing through the brain and nerves, cleansing the muscles) coupled to neural sentience, or 'the medullary part of the brain, spinal marrow, nerves, organs of sense and of the muscles'.[100] This flagrant lack of specificity about where the mechanisms of sensation imbricate with perception — the interface of sign and biology — is characteristic of a range of early nineteenth-century writings. It reminds us that by the early 1800s, anatomical drawings and language, what Michel Serres once called 'the empire of signs', was an ageing dominion of knowledge that excluded the experience of bodies, leaving the experience of sensation, and the possibility of their own codes of meaning, inscrutable.[101]

Cuvier, the 'father of comparative anatomy', was cautious from the outset.[102] Materialists' scrutiny of fibrous neural mechanisms offered no route to understanding sentience, he warned. Like Darwin, he sidestepped attempts to explain 'the production of a sensation' itself, calling it 'a mystery *impenetrable to our intellect*'; after all, empirical work on animal bodies could yield no answer, so any theoretical speculation remained ungrounded.[103] His vast taxonomy of animal forms, *Le Règne animal* (1817), which ensured his pre-eminence within the French life sciences, noted only that both internal and external organs were permeable by particular kinds of sensation or irritation. Amid his typological endeavour, then, there was no attempt to understand animal ears or eyes as the generator of particular sentient experience; the absence and presence of organs was merely a fact of classification ('many animals have neither ears nor nostrils; several are without eyes, and some are reduced to the single sense of touch, which is never

[99] Darwin's ostensive task had been to order the facts of animal life so as to 'unravel a theory of diseases'; *Zoonomia; Or, the Laws of Organic Life* (J. Johnson, 1794; repr. Thomas & Andrews, 1809), p. 1. Cf. Marcello Barbieri, 'A Short History of Biosemiotics', *Biosemiotics*, 2.2 (2009), pp. 221–45, doi:10.1007/s12304-009-9042-8.

[100] Darwin, *Zoonomia*, p. 5. On the intersection of the auditory nerve, brain fluids, and a drenched soul in German Romanticism, see Veit Erlmann, *Reason and Resonance: A History of Modern Aurality* (Princeton University Press, 2010), pp. 151–84.

[101] Michel Serres, *Conversations on Science, Culture and Time*, trans. by Roxanne Lapidus (University of Michigan Press, 1995), p. 132. On the basic view that senses should not be treated as suprahistorical, see Robert Jütte, *A History of the Senses: From Antiquity to Cyberspace* (Polity, 2005), p. 8.

[102] Cuvier's historiographic significance is underscored in Karl Vogt, *Lehrbuch der praktischen vergleichenden Anatomie*, 2nd edn (Vieweg, 1888), p. 1; and E. S. Russell, who posited him as one of the century's greatest comparative anatomists; *Form and Function: A Contribution to the History of Animal Morphology* (John Murray, 1916), pp. 31–44. Cf. Dorinda Outram, *Georges Cuvier: Vocation, Science, and Authority in Post-Revolutionary France* (Manchester University Press, 1984), pp. 189–202.

[103] Georges Cuvier, *Cuvier's Animal Kingdom*, trans. Edward Blyth, Robert Mudie, George Johnston, and J. O. Westwood (Baker & Darby, 1840; orig. *Le règne animal*, A. Belin, 1816), p. 25. His scepticism over materialism was old-fashioned, and stemmed from the belief that 'philosophy can furnish no direct proof of the actual existence of matter'. In this, he echoed the outlook of the French physiologist François Magendie (1758–1855), who introduced animal experimentation into scientific medicine and famously eschewed theoretical speculation, likening himself to a ragpicker (*chiffonier*): 'With my spiked stick in my hand and basket on my back, I traverse the field of science and I gather what I find.' Cited in *History of Anatomy: An International Perspective*, ed. by R. Shane Tubbs and others (Wiley, 2019), p. 114.

absent').[104] Detecting a cochlea, oval window, auditory meatus, or chain of ossicles mattered insofar as it affected form, and hence schematic order. The problem, in short, was that while sensationalism implicated animal anatomy within the same epistemic order that held sense acuity to be the governing framework for (human) aesthetics, the lack of any means for ascertaining the experience of animal sense modality or acuity meant that anatomists with reputations to defend, such as Cuvier, felt it safer to give up any pretence at understanding it.

Signs versus General Laws

After this failure of physiological anatomy, it may be no coincidence that a semiotic theory emerges at precisely this time of need. As is well known, a theory of the sign character of sentient experience would first emerge in 1867, with Charles Sanders Peirce's 'New List of Categories', which set out from the premise that 'conceptions' exist to reduce the plethora of sensory impressions to unity, whose necessity for understanding the content of consciousness validates those particular conceptions.[105] By introducing 'a concept of gradation among those conceptions which are universal', Peirce famously proposed a framework (initially *likeness*, *indices or signs*, *general signs*; later *icon*, *index*, *symbol*) to systematize the content of conscious sense impression according to a theory of three kinds of representation. While these conceptions sought universality without specifying the human limits of that universality, their initial explanation via verbal syntax indicates a 'human' universality in Feuerbach's sense: 'The unity to which the understanding reduces [sense] impressions is the unity of a proposition. This unity consists in the connection of the predicate with the subject.'[106] With common verbs like 'to be' (as in 'The stove *is* black'), the potentially indefinite determinations of the predicate led Peirce to realize graphically eight 'possible extensive relations of subject and predicate', sketched in the early 1860s (see Figure 1), underscoring how these different kinds of relation subsisted initially within the computational potential of language rather than in suppositions about the mechanisms of neural stimuli.

Nevertheless, his semiotic theory would later be applied to understandings of the history of sense mechanism, most notably in Tomlinson's recent trilogy of texts on evolution, setting out from his multi-disciplinary study of the evolution of human musicking, *A Million Years of Music*.[107] Here, building on the work of anthropologist Terence Deacon, Peircean semiotics affords an alternative to tracking developmental laws (after Cuvier et al.), namely by refining extant theories of 'symbolic cognition', or the evolved capacity of hominins to make symbols or create meaning in relation to the

[104] Cuvier, *Animal Kingdom*, p. 25.
[105] Charles S. Peirce, *Peirce on Signs*, ed. by James Hoopes (University of North Carolina Press, 1991), p. 23.
[106] Ibid., p. 24.
[107] Tomlinson, *A Million Years*; Tomlinson, *Culture and the Course of Human Evolution* (University of California Press, 2018); Tomlinson, *The Machines of Evolution and the Scope of Meaning* (Zone Books, 2023).

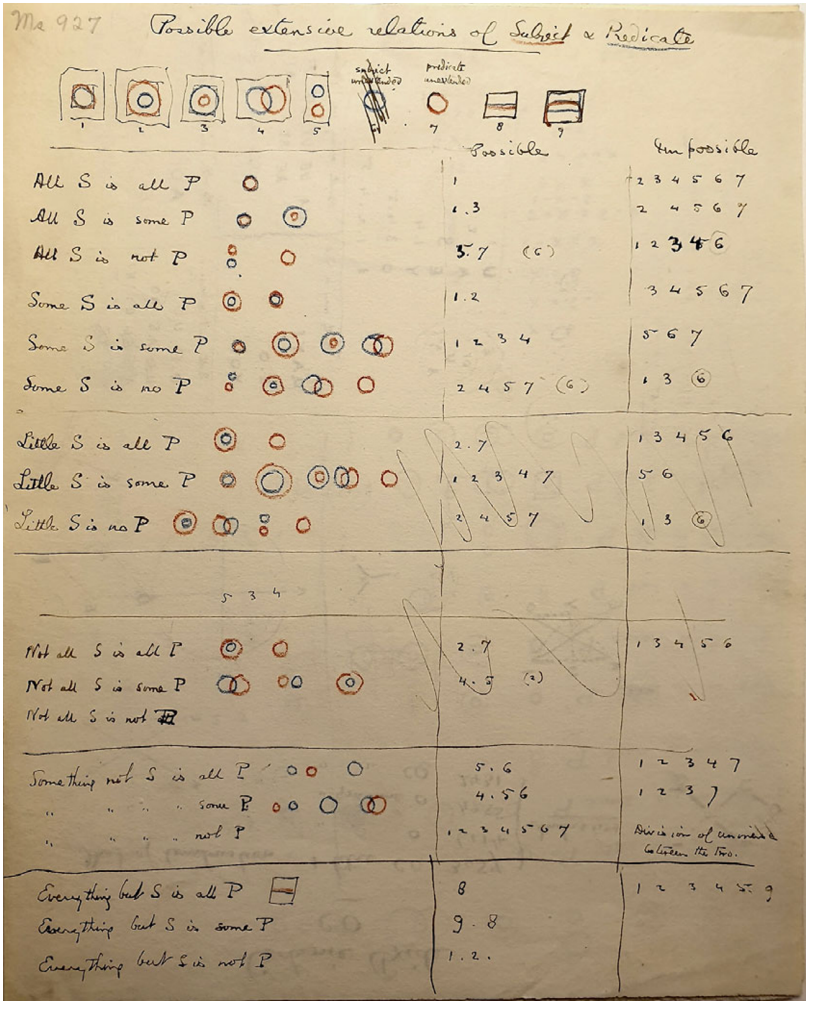

Figure 1. Charles Sanders Peirce's graphic realization of the permutations for all 'possible extensive relations of Subject and Predicate', via the geometric relationships of blue and red signs, *c.* 1864. Source: Houghton Library, Harvard University, bMS Am 1632 (927). Used with permission.

sign character of stimuli received. This is specifically construed as 'meaning, reference and referentiality, and representation', and Tomlinson is careful to differentiate the sign-making of some animals from the simple processing of 'contentless […] information' by all living things in order to 'distinguish discrete processes and levels of complexity involved in organismal response and cognition'.[108] In other words, Peircean methods have led to a call for so-called 'phylogenetic cognitivism […] to include

[108] Tomlinson, *A Million Years*, p. 173; Tomlinson, *Culture and the Course*, p. 71.

[…] accounts of the emergence of the modern human mind', with an obvious corollary in modern human listening.[109]

Specifically for a theory of evolution, this symbolic cognition is refined to account for listening practices, where sound (ostensibly a signalling device) points to no sign, just as Feuerbach's human sentience points to no environmental need; Tomlinson's key insight is the notion of 'an indexical systematicity',[110] i.e. a capacity of hominins to adapt the semiotic system of creating meaning from indexical gestures that point to the presence of a thing ('ancient gesture-calls') to a system of discrete pitch organization, i.e. a set of sonic references that have become abstracted from whatever they initially pointed to, therefore leaving quasi-indexical signs without any symbolic value: 'For hundreds of millennia and across at least several species [of hominins], the elaboration of indexicality toward greater complexity, precision and ordering predominated, with little or no trace of symbols.'[111] Nearly two centuries after Peirce, this adaptation of semiotics allows Tomlinson to postulate categorical differences in the sign-making capacity of humans in an otherwise continuous phylogenetic history. Okay, you say, but to what extent does it apply to animals?[112] Here Cuvier's problem returns. On the one hand, for theorists Eva Jablonka and Marion Lamb, the abstraction of symbolic value from a stimulus is a 'diagnostic trait of human beings'; on the other hand, the perception of likeness or iconic similarity (Peirce's first kind of representation) is 'shared by a wide array of cognizant species, in principle by any organism with a neuromuscular system'.[113] From today's perspective, semiotics demonstrably provides an intellectual framework for animal sentience, then, and while its dissemination as an intellectual proposition emerged in the decade of *Tristan und Isolde*, there are no traceable points of contact with the early discipline of comparative anatomy (which, again, perhaps reflects the habits of exclusion in Agamben's machine, where all semiotics implicitly focused on modes of representation for highly educated humans).

So what, if anything, was the role of Cuvier's work in shaping musicological knowledge, given the absence of a method to assess the sign character of sentient experience? If he can be said to have had an influence on nineteenth-century *Musikwissenschaft* at all, it concerns his advocacy of natural laws. His opening sentence defined the project of comparative anatomy as 'the laws of the organization of animals, and of the modifications which this organization undergoes in the various species'.[114] Seventy years later, the stated principles underlying Guido Adler's (1855–1941) influential prospectus for musicology in 1885 would see 'the actual focal point of all music-historical work' as 'the investigation of the laws of art of different periods'.[115] His ensuing history of tonal music (*Der Stil in der Musik*) famously grouped works

[109] Tomlinson, *A Million Years*, p. 177.
[110] Ibid., p. 193.
[111] Ibid., p. 201.
[112] On the implications of this question, see Tomlinson, *The Machines of Evolution*, pp. 133–44.
[113] Cited in Tomlinson, *A Million Years*, pp. 178 and 190.
[114] Cuvier, *Animal Kingdom*, p. 1
[115] Guido Adler, 'The Scope, Method, and Aim of Musicology', trans. by Erica Mugglestone, *Yearbook for Traditional Music*, 13 (1981), pp. 1–21 (p. 8), doi:10.2307/768355.

(*qua* organisms) into stylistic periods as 'a plurality of individual organisms whose exchangeable relations and co-dependence form a whole. Here law and chance intertwine in art, in just the way that […] [others have] posited them in relation to natural phenomena.'[116] In his early 20s, Adler's immediate source had been the prominent biologist and Darwinist Ernst Haeckel (1834–1919), snippets from whose evolutionary writings he copied out by hand in 1878.[117] Shortly thereafter, the opening statement of his doctoral dissertation made the key move, positing works explicitly as body forms or organisms whose growth is beholden to a law-governed teleology: 'The development of tonality is organic. In a steady succession, one moment of development follows the other in order to bring the organism to perfection.'[118] The particulars of this analogy were severe and self-serving. Within the period of tonality itself, his model would attribute to musical works a specifically stylistic progression 'in accordance with the laws of organic evolution', from archaic to classical and finally mannerist growth [*Manieristen*] — categories that underscore the cultural power that anatomically derived laws wielded over art.

Back in 1814, Cuvier's claim had carried the authority of the nascent discipline. An inductive approach, postulating general laws on the basis of specific corpora, was new for anatomy; it famously led Cuvier to hypothesize a genealogy of four body archetypes (*embrachements*), separable by their organization.[119] 'Only organized bodies can enjoy life', he explained, for each 'has one proper form, not only in general and externally, but also in the detail of the structure of each of its parts'. From this it followed that 'the *form* of a living body is more essential to it than its *matter*', for matter is ceaselessly replaced.[120] The laws arising from a visual array of organized forms, from Cuvier's 'law of correlation' ('give me the bone, and I will describe the animal') to the laws of function versus those of morphology, even formed the topic of a public debate with naturalist Étienne Geoffroy Saint-Hilaire (1772–1844) at the French Academy of Sciences in 1830.[121] Paradoxically, the

[116] 'Die Tonkunst ist in Organismus, eine Pluralität von Einzelorganismen, die in ihren Wechselbeziehungen, in ihrer Abhängigkeit voneinander ein Ganzes bilden. Da greifen Gesetzt und Zufall, wie dies Franz Exner bezüglich der Naturerscheinungen aufgestellt hat, in gleicher Weise auch in der Kunst ineinander'; Adler, *Der Stil in der Musik* (Breitkopf & Härtel, 1911), p. 13.

[117] See Benjamin Breuer, *The Birth of Musicology from the Spirit of Evolution* (unpublished doctoral thesis, University of Pittsburgh, 2011), pp. 126–38.

[118] 'Die Entwicklung der Tonkunst ist organisch. In stetig Aufeinanderfolge reiht sich ein Entwicklungsmoment an das andere an, um den Organismus zur Vollendung zu bringen'; Adler, 'Die historischen Grundclassen der christlich-abendländischen Musik bis 1600', *Allgemeine musikalische Zeitung*, 44 (3 November 1880), p. 689.

[119] As Andrew Cunningham notes, the search for general laws of animal organization was new, reflecting Cuvier's attempt to elevate the organic world to something far closer to an experimental science; *The Anatomist Anatomis'd*, p. 378.

[120] Cuvier, *Animal Kingdom*, pp. 17–18.

[121] 'Give me the bone, and I will describe the animal' points to the identification of a strict relationship between part and whole, epitomized in the apocryphal statement attributed to him in New York by Samuel Latham Mitchell in 1810. See Gowan Dawson, *Show Me the Bone: Reconstructing Prehistoric Monsters in Nineteenth-Century Britain* (Chicago University Press, 2016), esp. pp. 1–16.

debate's unclear outcome left 'an extraordinary degree of unanimity on the issues brought forth', for the episode solidified the belief that natural laws must govern the animal corpus and could be extrapolated from corpora.[122] The resulting two-step process in comparative anatomy was summarized by a leading textbook: 'Empiricism is the first premise just as abstraction is the second.'[123] By the 1850s zoologists such as Karl Vogt would hold comparative anatomy to be nothing *but* a means of establishing laws.[124] Its primary goal, he explains, was to understand individual modifications according to their causes, and explicitly to 'restore the original type from which the various forms that come *before our eyes* have developed', exemplifying the belief among contemporary historians that to know the origin of something was to know its essence.[125]

If (for Adler et al.) this foreshadows certain *musical* hierarchies of work over individual performance, underlying structure over surface texture, and genealogical status over aesthetics or gnostics, we should remember that unlike works, animal bodies were not primarily metaphysical. Hence their modes of visual representation in Peircean semiotics were categorically different, as icons (body depictions) as opposed to symbols (score notation). Accepting this, we might conclude that Adler extrapolated a genealogy of musical styles that pass *before our ears*, just as Cuvier's and Vogt's lawfully organized bodies pass 'before our eyes', and that this has provided an enduring licence for categorizing non-physical ontologies arising from the analysis of score notation. For a history of animal listening, the practice of grouping taxonomies by morphological kinship rather than by likeness of sentient function appeared unassailable. After all, the former was ocular and intuitively persuasive, the latter (how bodies experience the world) couldn't be known with certainty; so the attempt to find common traits between 'traces of [sentient] orders', in Foucauldian terms, remains a story of false starts.[126]

[122] For two months Cuvier and Geoffroy debated whether animal structure should be explained by laws of function or morphology; that is, whether structure was created by God to fulfil a particular function or driven by an abstract force governing morphological change; see Toby Appel, *The Cuvier–Geoffroy Debate: French Biology in the Decades before Darwin* (Oxford University Press, 1987), p. 202.

[123] 'Die Empirie ist somit die erste Voraussetzung, wie die Abstraction die zweite ist'; Carl Gegenbaur, *Grundzüge der vergleichenden Anatomie*, 2nd edn (Engelmann, 1870), p. 5. This would become emblematic of the two-stage positivism crystallizing within natural science, 'first, ascertaining facts; secondly, framing laws', in R. G. Collingwood's classic definition from *The Idea of History* (Clarendon Press, 1946; repr. Oxford University Press, 1980), p. 126.

[124] '[…] ist zwar die Grundlage der von uns behandelten Wissenschaft, bleibt aber dennoch nur ein Mittel zur Begründung der Gesetze, nach welchen die einzelnen Modificationen sich unter dem Einflusse verschiedener sie bestimmender Ursachen entwickelt haben'; Vogt, *Lehrbuch der praktischen vergleichenden Anatomie*, p. 1.

[125] 'Wir suchen durch die Zootomie den ursprünglichen Typus herzustellen, von welchem aus die verschiedenen Bildungsformen, die uns vor Augen treten, sich hervorgebildet haben'; ibid., emphasis added. Cf. Carl Dahlhaus, *Foundations of Music History*, p. 1.

[126] Michel Foucault, *Aesthetics, Method, and Epistemology*, trans. by Robert Hurley, ed. by James Faubion (Penguin, 1998), p. 262.

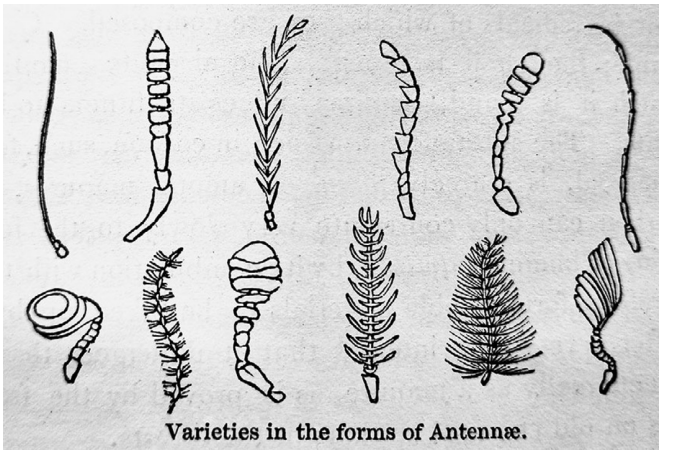

Figure 2. Hercule Strauss-Durkheim's illustration of twelve insect antennae; 'On the Antennae and the Hearing of Insects', *The Field Naturalist*, 1 (1833), p. 61.

False Starts and Fish Ears

Indeed, historians of the nineteenth century are confronted by the persistent failure of knowledge about animal hearing to gain a secure foothold in the respectable work of anatomical dissection. 'Who shall decide when doctors disagree?' mused one popular account on auditory sense in lobsters from 1864; its author, William Houghton, raised a sceptical eyebrow at the French naturalist Alfred Moquin-Tandon (1804–63), who had argued optimistically that molluscs, too, were cognisant of sound, before adding that hearing in insects 'has long been a disputed point'. His brisk survey of animal hearing closed by recommending an ironic '*silent* hymn of praise' to the Creator of all things.[127]

This is not to say the enterprise is a story of simple failure. Beyond popular readings and coffee-table anthologies such as *Brehm's Animal Life* (1873), the question of insect hearing proved a lightning rod for speculation among professional anatomists.[128] As the Finnish anatomist Eric Bonsdorf (1810–98) acknowledged, the spectrum of opinion was wide. Many anatomists denied any sense of hearing to insects (among them Linnaeus, whom we met earlier); some pronounced it doubtful and unknown, while a fringe minority regarded it as a certainty.[129] A representative from this latter group is the Paris-based naturalist Hercule Strauss-Durckheim (1790–1865), who likened insect antennae to the strings of the aeolian harp, vibrating mechanically according to different aerial undulations; they perform the same function as the three bony ossicles in the human middle ear, he thought, yet the

[127] W. Houghton, 'The Sense and Organ of Hearing in Different Animals', *Good Words* (January 1864), pp. 710–14 (p. 714).
[128] Alfred Brehm, *Brehms Illustrirtes Thierleben für Volk und Schule* (Bibliographisches Institut, 1873).
[129] Eric Bonsdorf, 'On the Antennae of Insects as Organs of Hearing', *The Field Naturalist*, 1 (1833), pp. 296–97.

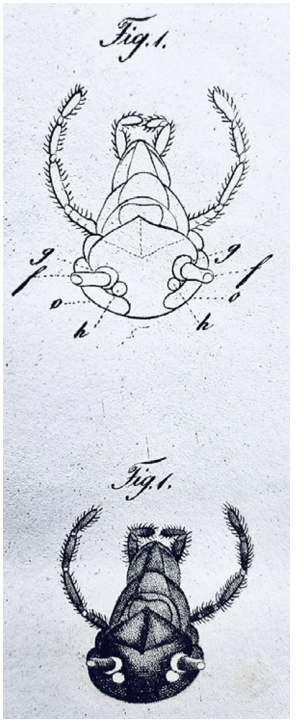

Figure 3. Gottfried Treviranus's illustration of 'the alleged organ of hearing' ['die muthmasslichen Gehörorgane'] in the common cockroach. This membrane-covered hole is given as *hh*, where *oo* = the eyes, *ff* = the lowest limbs of the cut-off antennae, *gg* = pits in which the antennae sit. Treviranus, 'Resultate einiger Untersuchungen über den inner Bau der Insekten', *Annalen der Wetterauischen Gesellschaft für die gesammte Naturkunde*, 2 (1809), pp. 169–73.

sheer diversity of forms, of which he catalogued twelve (Figure 2), left a daunting gulf between form and function that demanded we 'admit numerous differences of functions'.[130] In similar vein, the Leipzig-based physician Ernst Weber argued that once the possibility of different functions is accepted, hearing in insects 'can hardly be doubted', for it allows for cross-modal mechanisms for auditory perception, e.g. receiving sound by wing movement and the body's surface of 'horned shields'.[131] It was amid equal clouds of uncertainty that the German physician Gottfried Treviranus (1776–1837) uttered what no musicologist wants to hear: 'I have discovered the organ of hearing in the common cockroach' (Figure 3).[132] But again, the ultimate purpose of the semicircular membrane he uncovered, with its neural extensions connecting brain to antennae, remained guesswork: 'The similarity […]

[130] Hercule Strauss-Durckheim, 'On the Antennae and the Hearing of Insects', *The Field Naturalist*, 1 (1833), p. 61.
[131] 'Corpus enim, scutis corneis tectum, organo auditus sedem aptissimam offert. Adesse igitur hunc sensum vix dubitari potest, in iis praesertim generibus, quae sonos alarum motibus et alio modo cient, ut gryllus, musca, aliaque genera'; Ernst Weber, *De aure et auditu hominis et animalium* (Fleischerum, 1820), p. 3.
[132] Treviranus, 'Resultate einiger Untersuchungen', p. 169.

with an ear drum […] seems so conspicuous to me that anyone who sees this part must immediately suppose it to be the ear of a cockroach.'[133] Amid such imaginative play, Bonsdorf soberly put his finger on the methodological challenge of attributing auditory response to animals in the shadow of human aurality:

> When these authors […] admit the perception of sounds, and yet deny the organ of hearing, they appear to me to stand in the same predicament as if they had said that insects indeed hear, but yet *they do not hear truly*; than which nothing could be conceived or expressed more absurd.[134]

In the aural imagination, if hearing without ears was not 'true', what it was remained uncertain. To imagine what cannot be heard not only contradicted the central tenet of sensationalism, it invited potentially limitless supposition. So for Bonsdorf, whether antennae might perform the same function as ears was a 'very difficult question', prompting him to stretch credulity by likening their form and hollow structure to semicircular canals, which — his assembled sources led him to believe — most likely correspond to 'the seat of hearing, or receptacle of the impression of sounds'.[135] In short, beyond myriad erroneous conclusions, the attribution of partial hearing to 'lower' organisms originated in a pervasive uncertainty of form and function, coupled to beliefs over biological hierarchy. As such it functions as a metonym for broader assumptions about 'untrue' hearing at the time among animality *in toto*.

A representative case is the popular question of whether or not fish could hear. As with insects, this prompted a range of speculative articles and pamphlets as well as correspondence and commentary, from the *Transactions of the Royal Society* in London to Weber's Latin tract *On the Ears and Hearing of Man and Animals* (1820), part 1 of which concerned the aural system in fish (*De aure animalium aquatilium*).[136] At stake was whether hearing could be proven to exist without external organs and how experiments concerning behaviour might plausibly show this. At root, however, the underlying question was subtly different: just how low did the auditory Chain of Being go?

As early as 1650, the Jesuit polymath Athanasius Kircher had wondered if fish were an endpoint, deaf and mute. In his *Musurgia universalis*, he compared the anatomical shapes and functions of ear parts across mammals. His cutaway presentation of 'the aural organs of various animals', reproduced in Figure 4, is indicative of the intuitive assumption that hearing required visible organs for channelling vibrations, not least external pinnae. Fish had none, so were immediately problematic. 'It is doubtful whether fish have ears', he remarked; the holes below the eyes could be designed for hearing *or* smelling, he suggested: 'nobody has adequately investigated' — an indicative judgement that would be parroted until Weber's treatise in 1820. Kircher surmised

[133] 'Mir scheint die Aehnlichkeit der elastischen Membran ab mit einem Trommelfell […] so auffallend zu seyn, dass jeder, der diesen Theil erblickt, in ihm sogleich das Ohr der Schabe vermuthen muss'; ibid., p. 170.
[134] Bonsdorf, 'On the Antennae of Insects', p. 297; emphasis added.
[135] Ibid.
[136] See note 131.

Figure 4. Athanasius Kircher's illustration of the anatomy of different animal ears. Box from left to right: human, cow, horse, dog, followed by leopard, cat, above rat, pig, then sheep and goose. Folio 14 in *Musurgia universalis*, 2 vols (1650), I, p. 12.

incorrectly that the density of water slows down sonic vibrations for aquatic creatures such as whales or seals, causing hearing 'in a muffled way […] they have not a refined organ of hearing like terrestrial creatures'.[137] His words were still quoted in the 1760s, with popular summaries appearing as late as the 1870s,[138] by which time a litany of experiments — ranging from comical to fiercely detailed — had primed the debate.

The English naturalist William Arderon (1703–67), for example, after placing various fish in glass jars and observing no reaction from his aquatic subjects to 'whistling, howling, and the sounds of several musical instruments' nearby, explains that he flicked the glass with his thumbnail, and, receiving little reaction, reported to the Royal Society in 1748 that in the 'highest probability, [fish] are really destitute of that Sense'.[139] Decades later, John Hunter concluded contrariwise that 'it is evident fish possess the organ of hearing', after he observed 'three curved tubes […] semi-circular canals' in tiny cavities made of cartilage that project laterally from the sides of salmon and cod skulls. His empirical proof was thin, however,[140] and he would be corrected by Weber, whose dissections revealed in 1820 that lampreys (*Petromyzon*) are in fact destitute of semicircular canals, and their auditory nerves 'do not belong to the ear'.[141] Weber concludes his study with twenty-seven 'new observations' about the aural anatomy of fish, revealing an astonishing range of empirical minutiae that counted as pioneering knowledge of anatomy, if not of aquatic auralities.[142] Three sample observations are:

- The ray's ear has not one but two external passages for receiving sound (the windows of the vestibulum membranaceum and the vestibulum cartilaginieum, which he likens to the oval and round windows, respectively, in humans).[143]
- The ossicles in carp convey vibrations directly to the cranium, via two auditory 'holes' (*fossae*) through which an oily fluid transmits vibration from the auditory canal to the cranium cavity via two occipital bones.[144] (See Figure 5a.)

[137] 'Pisces nu aures habeat dubium eit. […] Nam pisces (quibus pulmo, quo alia animantia spiritum atque aërem ducunt redduntque deest) qua parte audiant, à nemine adhuc penitus exploratum est. […] Pisces enim intra qauam tanquam intra medium crassis specierum soni retardatiuum vti obtusè audiunt, ata tam exquistum quoque organum auditus non habent, ut relique animantia terrestria, quae in media aëreo degunt'; Athanasius Kircher, *Musurgia universalis*, 2 vols (Francesco Corbelletti, 1650), I, 12.

[138] See Rodolphe Radau, *The Wonders of Acoustics*, trans. by Robert Ball (Cassell, Petter and Galpin, 1870), pp. 8–9.

[139] William Arderon, 'Extract of a Letter from Mr William Arderon, F. R. S. to Mr Henry Baker, F. R. S. Concerning the Hearing of Fish', *Transactions of the Royal Society*, 45 (31 March 1748), pp. 149–55 (pp. 153–54).

[140] A nobleman concealed by a shrubbery (to avoid affecting the light visible to the fish) fired a gun near his teeming fish pond, allegedly sending the fish straight into the muddy bed. See Hunter, 'Account of the Organ of Hearing', pp. 381–83.

[141] 'nervi auditoria accessorii plane non ad aurem pertinent'; Weber, *De aure*, pp. 134; cf. pp. 36 and 103–04.

[142] Ibid., pp. 129–34.

[143] Ibid., pp. 130–31; see point 19 on Weber's list of conclusions, pp. 132–33.

[144] See point 9 on Weber's list of conclusions, pp. 130–31.

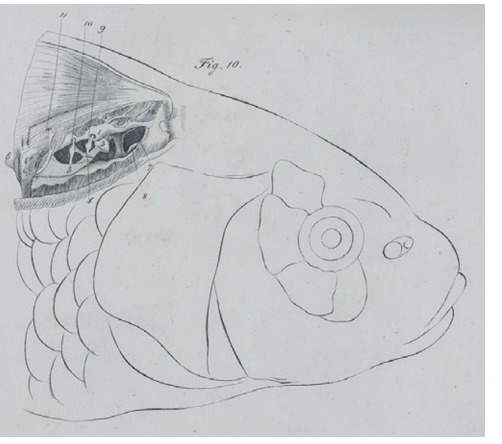

Figure 5a. Ernst Weber's illustrations of unusual aural mechanisms in carp. Nos. 3–5 show the incus, malleus, and stapes (ossicles) in the common carp, connecting directly to the cranial cavity via an oily fluid; no. 7 shows the occipital foramen 'through which the membranous auditory fossa has free communication with the cranial cavity' ['per quod fossa auditoria membranacea liberum cum cranii cavo commercium habet']. It implies a role for bone vibration in auditory perception. Weber, *De aure et auditu hominis et animalium* (Fleischerum, 1820), Figure 10 and 'Explicatio tabularum', pp. 7–8.

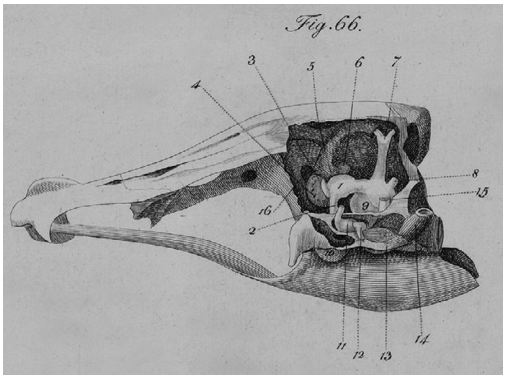

Figure 5b. Ernst Weber's illustrations of unusual aural mechanisms in herring. No. 2 shows the membranous canal connecting the two membranous vestibules of the inner ear in herrings. This implies a direct material link between left and right auditory perception. Weber, *De aure et auditu hominis et animalium* (Fleischerum, 1820), Figure 66 and 'Explicatio tabularum', pp. 21–22.

- In herrings, the right and left membranous vestibules of the inner ear actively 'communicate […] by means of a transverse membranous canal' below the brain, where mercury injected in one side ends up in the other, suggesting a materially shared aural effect between 'ears'.[145] (See Figure 5b.)

[145] 'Pars anterior vestibuli membranacei dextri Clupeae Harengi cum parte anteriori vestibuli membranacei sinistri per canalem membranaceum transversum, sub cerebro praetereuntem, ita communicat'; ibid., p. 132. See point 15 on Weber's list of conclusions, pp. 132.

Readers encountering such thickets of anatomical detail were offered no matching postulates about the auditory perception resulting from these forms, e.g. that carp skulls might vibrate in the perception of sound, or that a materially shared effect might link both sides of a herring's inner ears. Instead, the explanatory strategy is anthropomorphic. In the absence of a mammalian cochlea, i.e. a dedicated auditory organ, a majority of fish possess three tiny bones on each side of their skull, which may be compared — we learn — to the stapes, incus, and malleus in humans, just as the two cavities (*atria*), that are in turn shut by the movement of the stapes, may be compared to the oval window in humans.[146] Comprehending anatomical form and function by comparison to human bodies was a familiar strategy, as a form of analogy.[147] Yet in bridging human–animal forms by reference to the former, it also reflects a necessarily human-centric mode of thought (cf. Lange's teleology), and it is perhaps no coincidence that Weber's major treatises on the sensation of touch, *De tactu* (1834) and *Der Tastsinn und das Gefühl* (1846), would concern humans alone, arising in large part from empirical work on his own body.[148]

Separately, the more testable question of how efficiently water could transmit sounds sheds light on a certain naivety within contemporary empiricism. Arderon, for his part, devised two experiments: words spoken on the river bank were clearly audible by a swimmer submerged two feet, he reports; a gunshot was audible twelve feet underwater. The lunacy of inverting this test — by first ringing a submerged bell, then throwing 'a kind of Hand-Granado' underwater to see if sound made below the surface was audible above — is indicative of the brute curiosity characterizing such gentlemen naturalists. But it also marks the frustrations of method in such an intractable quest. Among his many letters to the Royal Society, Arderon dutifully reported both the 'prodigious hollow Sound' of the underwater grenade and the softly ringing bell.[149] It was received politely at the Society, without further comment.

The later application of different aural experiences to animal anatomies that arise from a watery medium represents a first strike at the assumption that human aurality was sovereign. Speculation crystallized around how effectively sound was communicated for fish and amphibians versus mammals and birds. In one case, the Scottish anatomist Alexander Monro (1733–1817) had written of how 'the tremor of the chain of small bones will be much less interrupted by air than it would have been by a watery liquor filling the cavity of the timpanum', meaning that for amphibious creatures 'two different impressions are made on the membrane of the oval hole': one above the water (resulting in stronger sound impressions) and one below. Published in 1785, his views

[146] Ibid., p. 56.
[147] As early as the fourth century BC, Aristotle had acknowledged 'we will consider the parts of the human body; as every one can best understand the standard of money with which he is most familiar, so it is in other things. And of necessity, man must be the best known to us of all animals'; *History of Animals*, p. 11.
[148] Both texts appear in Weber, *The Sense of Touch*, trans. by H. E. Ross and D. J. Murray (Academic Press for Experimental Psychology Society, 1978).
[149] Arderon, 'Extract of a Letter', p. 155.

built on Aristotle's 'two classes' of aquatic animals, i.e. those that exist entirely within water, and those that breathe air. They were conjectural but acquired nuance through experimentation.[150] After failing to hear a ticking watch he placed between his tongue and the roof of his mouth, he determined that the purpose of the Eustachian tube must be to furnish air to the tympanic cavity rather than to receive impressions, and he differentiated the split auditory world of genuine amphibians from that of whales, who appear amphibious but whose physiological need for breath ensured their ears were primarily 'calculated to receive sound from the air by an external meatus'.[151] If Monro's speculations were guided by physical form and the facts of anatomical knowledge, others, such as the French surgeon Claude-Nicolas Le Cat in his *Physical Essay on the Senses* (1750), were less constrained: the absence of a cochlea meant no sensibility for harmony, rendering all cochlea-less animals 'as stupid as Fish', while the unusually keen hearing of birds, he proposed, simply resulted from their heads' lack of 'complicated muscles', leaving them 'almost entirely sonorous like a Bell. Hence must they necessarily be agitated by the sounds which present them.'[152] His anticipation of the same logic that would inform Strauss-Durckheim's aeolian antennae underscores the slippage between imagination and biological theory that hindered any serious attempts to 'hear into' another organism's environment, even while it remains the case that disputes over animal abilities more typically centred on 'problems of brute instinct and intelligence' rather than on anything approaching aesthetic judgement.[153]

To be sure, the same slippage is mirrored in certain pronouncements about human hearing, as guided by a latent music-theoretical imagination. In 1826, the leading young physiologist in Germany, Johannes Müller, decried the 'many useless hypotheses about the function of the [ear's] individual parts', noting there was not 'a multitude of strings' to discover in the eardrum, varying their lengths according to the drum's dimensions (cf. Justinius Andreas Kerner), nor were the semicircular canals formed in the proportions of a single triad, the octave, the third, and the fifth (cf. Andreae Comparetti): 'We do not see in the cochlea a musical instrument,' he asserts firmly, 'but only a very perfect apparatus for exposing all individual parts of the nerve to tremors.'[154] To study this more objective 'perfection', he proposed a process of deduction based on the size of the auditory nerve and the laws of sound conduction. But for leading acousticians such as Ernst Chladni, even theories of mechanical

[150] Aristotle, *History of Animals*, pp. 2–3.
[151] Alexander Monro (*secundus*), *The Structure and Physiology of Fishes Explained and Compared with Those of Man and Other Animals* (Charles Elliot, 1787), p. 55.
[152] Le Cat, *A Physical Essay on the Senses* (R. Griffiths, 1750), pp. 57–58.
[153] Richards, 'The Emergence of Evolutionary Biology', p. 243.
[154] 'Durch diesen aus den Gesetzen der Schallleitung entwickelten Begriff von der Entstehung des Gehörorganes bis zu seiner vollkommensten Ausbildung sind wir vor vielen unnützen Hypothesen über die Function einzelner Theile des Organes befreit. […] Wir sehen in der Schnecke kein musikalisches Instrument, sondern nur einen sehr vollkommenen Apparat, alle einzelnen Theile des Nerven der Erzitterung auszusetzen'; Müller, *Zur vergleichenden Physiologie des Gesichtssinnes des Menschen und der Thiere* (Gnobloch, 1826), pp. 449–50. Cf. Justinus Andreas Kerner, *De functione singularum partium auris* (Hopfferianis, 1808); Andreae Comparetti, *Observationes anatomicae de aure interna comparata* (Bartholomaeum, 1789).

propagation fell short. His summary of recent literature on animal ears, in the final chapter of his *Treatise on Acoustics* (both 1802 and 1809 editions), could only follow Cuvier's lead in ignoring the 'mystery impenetrable to our intellect'. Commentaries on hearing in everything from cuttlefish to insects, salamanders to birds, are dutifully referenced, but their peripheral status was obvious. The pithy summary that closes the final short chapter on animal hearing was conceived less for rhetorical weight than for eyebrow-raising curiosity: 'The organs required for hearing are found, therefore, in all animals examined up until now, but some auxiliary organs, designed to hear more perfectly, are located only in some classes of animals.'[155] The nature or telos of this perfection, and its distribution between classes, remained an open question. Chladni's chapter amounts to tokenism, where brevity reflected a sense that serious experimentalists ought to engage the claims of eighteenth-century naturalists about animal sentience, but that these were so fraught with methodological uncertainty that harmless synopsis offered the lesser evil.

Feuerbach's Animals

> What had really induced me to attach so much importance to Feuerbach was his conclusion that the only reality was that which the senses perceived.
>
> Richard Wagner[156]

Not so for Feuerbach, who took up the question of animal sentience directly. He studied Cuvier's writings on animals while completing his doctorate in natural sciences at the University of Erlangen (1827–28) and duly cited the Frenchman in the opening sentences of *The Essence of Christianity* (1841) regarding the limits of animal consciousness.[157] But while for him animal senses were limited, physiological 'man' took on some attributes of a Catholic God as 'the infinite being, the being *without any limitations*'.[158] How could this limitlessness align with the empirical limits of human aural perception — especially when it contrasts with the putatively

[155] Ernst Chladni, *Treatise on Acoustics*, trans. by Robert Beyer (Springer, 2015), p. 185. The principal texts consulted by Chaldni are given as: Antonio Scarpa, *Anatomicae disquisitiones de auditu et olfactu* (Pietro Galeati, 1789); Comparetti, *Observationes anatomicae*; lesson XIII from Cuvier's *Leçons d'anatomie comparée* (Crochard, 1805); Petrus Camper on the hearing of scaly fish, cuttlefish, and the sperm whale, in *Sämtliche kleine Schriften*, trans. by J. Herbell, 3 vols (1784–90), I, pp. 32–64; John Hunter, 'Observations on the Structure and Oeconomy of Whales', *Philosophical Transactions*, 77 (1787), pp. 430–37; Monro, *The Structure and Physiology of Fishes*; Étienne Louis Geoffroy, *Dissertations sur l'organe de l'ouïe de l'homme, des reptiles, des poisons* (Cavelier, 1778).

[156] Wagner, *My Life*, trans. by Andrew Gray (Cambridge University Press, 1983), p. 431.

[157] Feuerbach dismissed elephants' alleged capacity for religion, noting that Cuvier assigned, 'on the strength of his personal observations, no higher grade of intelligence to the elephant than to the dog'; *The Essence of Christianity*, trans. by Marian Evans (Chapman, 1854), p. 1.

[158] Feuerbach, *Principles of the Philosophy of the Future*, p. 6. Even though Cuvier's quartet of animal types — vertebrates, molluscs, articulated animals, zoophytes — undermined the Great Chain of Being's single hierarchy, Cuvier, too, placed humans at the apex of sensibility: 'The most perfect animals are infinitely below man in their intellectual faculties'; *Animal Kingdom*, p. 30.

'untrue' hearing of animals, despite humans and animals having 'senses in common'?[159] How, in other words, did Feuerbach distinguish animal sentience from human 'universal' sentience?

He addresses this riddle directly in 1843: 'Man is not a particular being, like the animals, but a universal being', he asserts, where 'universality, absoluteness, and freedom are inseparable'.[160] For the purposes of sense acuity, this unlimited freedom resides in the emancipation of sense faculties from their 'bondage to needs' (a dog's keen olfaction allows it to hunt, etc.). Once a sense is elevated above such mundane tasks and the evolutionary role they imply, it achieves aesthetic autonomy: 'an independent and theoretical significance and dignity; *universal sense is understanding*; universal sensation, mind'.[161] This explains why, adopting Kantian vocabulary, it is only man who finds 'heavenly bliss in the *purposeless* sight of stars' and who sates his ear on the 'voices of birds, the clanging of metals, the splashing of the springs, the rustling of the wind'.[162] By 1846, this contrast with animal perception resulted in a hyperbolic status for humans for whom perception was not subordinate to lower purposes of life, but 'an absolute entity, autotelic, self-enjoyment'.[163] In short, here the argument first emerges that humans take pleasure in aesthetic qualities while animals do not, meaning that animal sentience is denied a capacity for art: 'The object of [man's] sense, his feelings, are purely for himself, that is, for aesthetic enjoyment.' With this prize in sight, there is no contradiction (or rhetorical danger) in admitting what was already widely known, that the 'senses of the animal are indeed keener than those of man'.[164]

But what of the reality experienced by these keener senses? Did more acute non-human senses harbour the capacity for a different or truer reality? Feuerbach repeatedly emphasizes that it is precisely the 'reality' of sensuous perception that guarantees what is true for humans:[165] 'The real in its reality or taken as real is the real [only] as an object of the senses; it is the sensuous. Truth, reality, and sensation are identical.'[166] The consequences of telescoping these concepts together — in pursuit of 'freedom' from abstraction — now seem to us baldly deterministic: 'art, religion, philosophy, and science are only manifestations or revelations of the true human essence',

[159] 'Er hat die Sinne mit dem Thiere gemein'; Feuerbach, 'Wider den Dualismus', p. 371.
[160] Feuerbach, *Principles of the Philosophy of the Future*, p. 69.
[161] Ibid.
[162] 'Nur Er ist es, der aus dem zwecklosen Anblick der Sterne himmlische Wonne einsaugt […] Er ist es, der sein Ohr an den Stimmen der Vögel, an der Klang der Metalle, an dem Geplätscher der Quellen, an dem Sausen des Windes ergötzt'; Feuerbach, 'Wider den Dualismus', pp. 371–72; emphasis added. Friedrich Lange concurred with his anthropo-aesthetics, writing of 'the first beginnings of what is specifically human — that is, the appearance of the sense of beauty and the beginning of art [i.e. cave art and carvings in southern France] in times when man was obviously still living in savage conflict with the great beasts of prey'; *History of Materialism*, p. 101.
[163] 'Ein absolutes Wesen, Selbstzweck, Selbstgenuß'; Feuerbach, 'Wider den Dualismus', p. 371.
[164] Feuerbach, *Principles of the Philosophy of the Future*, p. 69.
[165] Ibid., p. 35.
[166] Ibid., p. 51.

i.e. endeavours that manifest intrinsically human physiological structures and their corresponding qualitative consciousness.[167]

This claim electrified efforts towards a modern physiological aesthetics. Indeed, it is this signal observation that prompted the 36-year-old Richard Wagner to dedicate his essay 'Das Kunstwerk der Zukunft' (1849) to the philosopher in the late 1840s.[168] 'Our surest grasp of reality', he writes to his former assistant conductor August Röckel in 1854, 'is through feeling, and true feeling is perceived exclusively through the senses.' The ensuing clarification echoes Feuerbach's illustration as though his book were in Wagner's hands:

> It must be added that what we understand here by 'senses' is not what philosophers or theologians mean when they speak with total contempt of the *animal* senses, but the *human* senses which, as is well known, are capable of measuring the stars and imagining their courses.[169]

The example was borrowed. Yet Wagner's original continuation of Feuerbach's views at the close of his essay 'Kunst und Klima' (1850) led him to predict a direct link between the sentient capacity of humans '*raised to the height of the universal human* [*allgemein Menschlichen*], *and therefore universally intelligible*' and his anticipation of '*all-human artworks*, of whose amplitude and splendour our aesthetic sense of today […] cannot conceive at all'.[170] He exuberantly predicts a universal mode of (human) sentient communication, in other words, whose universal intelligibility promises to do away with the need for music criticism (i.e. 'poetic literature […] [which] exists by the very reason that it exists apart from sentience') — all of which was rooted in a postulate of human physiology.[171] It would take three decades before the implications of this postulate would be outlined, by the French positivist critic and theorist Eugène Véron (1825–89), whose *L'Esthétique* sought to redefine aesthetics and artistic cognition as a science rooted in physiology and psychology. Its opening pulls no punches: 'Art is nothing but a natural result of man's organization, which is of such a nature that he derives particular pleasure from certain combinations of forms, lines, colours, movements, sounds, rhythms, and images.'[172] But as early as 1856, precisely the species specificity of this world view would be challenged. In his lectures on aesthetics at Göttingen, the philosopher Rudolph Hermann Lotze saw our 'definite human organization' as responsible for both 'our most valuable inner development' and also as 'a

[167] Ibid., p. 70.
[168] Wagner, *My Life*, p. 431.
[169] Wagner to Röckel, 25–26 January 1854, in Richard Wagner, *Sämtliche Briefe*, 9 vols, ed. by Gertrud Strobel and Werner Wolf (Deutscher Verlag für Musik, 1967–2000), VI, p. 61.
[170] '*allmenschlichen Kunstwerken* heranblühen, von deren Fälle und Herrlichkeit unser […] [heutiger] Kunstverstand sich gar keine Vorstellung zu machen vermag'; Wagner, 'Art and Climate', in *Sämtliche Schriften: Volks-Aufgabe*, 16 vols (Breitkopf & Härtel and C. F. W. Siegel (R. Linnemann), 1911–14), III, p. 220; *Richard Wagner Prose Works*, trans. by William Ashton Ellis, 8 vols (Kegan Paul, Trench, Trübner, 1892–99; repr. University of Nebraska Press, 1993–95), I, p. 265.
[171] 'Die dichterische Literatur selbst [ist] nur dadurch vorhanden […] daß sie ohne diese Sinnlichkeit vorhanden ist'; Wagner, 'On Musical Criticism', *SSD*, V, p. 58; PW, III, p. 66.
[172] Eugène Véron, *Aesthetics*, trans. by W. H. Armstrong (Chapman & Hall, 1879), p. v.

limitation […] which hinders us from transposing ourselves into the interior of creatures that are of a wholly different kinds from us'. Yet in an eyebrow-raising conclusion, he argues that 'music overcomes [this] limit', transcending even Wagner's human-universalism with a Neoplatonic appeal to 'the inner life and movement of the creative world […] that all-penetrating world-soul' whose human teleology remains firmly intact.[173] These voices — Feuerbach, Wagner, Lotze, Véron — are each grounded in *corpistemologies*, or epistemologies of a corpus. They signal the emergence of what Nietzsche, after Feuerbach, would formulate ironically as aesthetics as a form of 'applied physiology', and remind us that few reasons existed to question the particularity of human perceptual reality during the middle third of the century.[174]

Statements to this effect abound in Feuerbach's *Principles*, and within a decade, scientific materialists such as the Dutch physiologist Jacob Moleschott, a pugnacious atheist, would set out the implications concretely.[175] 'Does not all knowledge predicate a knower, consequently a relation of the subject to the observer?', he asked rhetorically.[176] 'And all facts, every observation of a flower, of a beetle, the discovery of a world and the eavesdropping on the peculiarities of humans, what do they reveal but relations of objects to our senses?' Such relations are material attributes without which knowledge is inconceivable, in other words. 'Neither God nor man can raise himself above the knowledge furnished by these relations to his organs of apprehension', he continues:

> So of course we know everything for ourselves, we know how the sun shines for us, how the flower smells for humans, how the vibrations of the air touch a human ear. This has been called limited knowledge, human knowledge conditioned by the senses, a knowledge that only observes the tree as it is for us.[177]

[173] Rudolph Hermann Lotze, *Outline of Aesthetics*, trans. by George Ladd (Ginn, 1886), p. 45.

[174] On the Germanocentrism of Wagner's implied spectators, see Kirsten Paige, '"Art and Climate" and the Atmospheric Politics of Wagnerian Theater', *The Opera Quarterly*, 35.3 (2019), pp. 1–32 (pp. 6–8), doi:10.1093/oq/kbz019.

[175] Examples from *Principles of the Philosophy of the Future* include: 'Certain and immediately assured is only that which is an object of the senses' (p. 55); 'Only the sensuous is clear as daylight […] The secret of immediate knowledge is sensation' (ibid.); 'Only that thought which is determined and rectified by sensuous perception is real and objective thought — the thought of objective truth' (p. 64). Contemporaries were struck by the build-up of such statements, including Friedrich Lange, who supplies his own list in *History of Materialism*, p. 249.

[176] 'Setzt nicht jedes Wissen einen Wissenden voraus, also ein verhältniß von dem Gegenstande zum Beobachter?'; Jacob Moleschott, *Der Kreislauf des Lebens: Physiologische Antworten auf Liebig's Chemische Briefe* (Zabern, 1852), p. 16.

[177] 'Und alle Thatsachen, jede Beobachtung einer Blume, eines Käfers, die Entdeckung einer Welt und das Belauschen der Eigenheiten des Menschen, was ergeben sie den anders, als Verhältnisse der Gegenstände zu unsern Sinnen? […] Ueber die Kenntniß jener Beziehungen zu den Werkzeugen seiner Auffassung erhebt sich kein Mensch und kein Gott. / Also wissen wir freilich alles für uns, wir wissen, wie die Sonne scheint für uns, wie die Blume duftet für Menschen, wie die Schwingungen der Luft ein Menschenohr berühren. Man hat dies ein beschränktes Wissen genannt, ein menschliches Wissen, bedingt durch die Sinne, ein Wissen, das den Baum nur beobachtet, wie er für uns ist'; ibid., pp. 15–16.

His views, echoing Kant (*c.* 1781) and anticipating Peircean semiotics (*c.* 1864), were flagged as incomplete by contemporaries, however. What of animal knowledge? As one reviewer put it:

> If all knowledge comes from the organs of sense, then differently formed organs must furnish very different and contradictory knowledge, and one is as likely to be correct as another. The radiate animal, who sees the world through a cornea alone, must have quite another notion of light, color, and relative size, from the spider whose eye is provided with lenses and a vitreous humour. Consonantly with the theory, each of these probably opposing views is equally true. This ugly dilemma is foreseen by our author [Moleschott], for he grants that 'the knowledge of the insect, its knowledge of the action of the outer world, is altogether a different one from that of man', but he avoids the ultimate result of this reasoning.[178]

By embracing such reasoning, and reading Feuerbach against the grain, we finally arrive at a historical platform on which to investigate the fracturing of the aural machine, and to assess the emergent methods and discourses surrounding a reality–truth–sense nexus that must in principle differ for differently equipped organisms, whether animal or human. To summarize, there are two stages to the emancipation Feuerbach articulates: the first from God to 'man' (his focus); the second from human to non-human bodies (my focus). The comparative relations are summarized in Table 1, where Cuvier's column sits alongside Feuerbach's system as a set of latent implications, and whose vacant box can only ask a historical version of Thomas Nagel's oft-cited question about what would constitute an animal's cognitive reality, and functions here as an undetermined historical concept.[179]

If the idiosyncratic sense character perceived by animal bodies ultimately remained an impenetrable 'mystery' (Cuvier), anatomically speaking, its existence alongside a network (Hanslick's law–organism–sound) that asserted traits of human reason through sound patterning established the sentient realities of human listening as neither singular nor isolated. This epistemic awakening provoked opposing reactions, and underscores the possibility that 'human musicking and human biophilia', i.e. pleasure in animal sounding, 'have a shared story to tell', as Holly Watkins argues.[180] Moreover, those opposing reactions between the mid-nineteenth and early twentieth centuries indicate just how far attitudes would shift, from reinforcing to powerfully fracturing the anthropocentric frame. In 1852, it prompted Moleschott to recommend that his fellow humans actively cultivate their knowledge of the senses, by researching all organisms' means of experiencing the characteristics of the same matter, allowing humanity to grasp the 'essence' of that matter, thereby achieving 'absolute knowledge' [*absolutes Wissen*].[181] Sixty years later,

[178] D. G. Brinton, 'The Metaphysics of Materialism', *The Journal of Speculative Philosophy*, 1.3 (1867), pp. 177–78.
[179] For Thomas Nagel, the conscious experience of a sentient animal is irreducible to corporeal facts, meaning 'that there is something it is like to *be* that organism'; 'What Is It Like to Be a Bat?', *The Philosophical Review*, 83.4 (1974), pp. 435–50 (p. 436), doi:10.2307/2183914.
[180] Watkins, *Musical Vitalities*, p. 131.
[181] Moleschott, *Kreislauf des Lebens*, p. 24.

TABLE 1

A comparative schema that maps Ludwig Feuerbach's anthropological materialism (*Grundsätze der Philosophie der Zukunft* (1843)) onto equivalent categories in Hegel's systematic idealism and Cuvier's animal bodies. Solid lines indicate Feuerbach's assertions; dotted lines indicate implications of his outlook.

Hegelian idealism	**Feuerbachian materialism**	**Cuvierian anatomy**
thought (speculative philosophy)	sensation (universal)	sensation (non-universal, need-based)
Theology	Anthropology	Zoology
God (immaterial)	human (material)	animal (material-mechanical)
unreal objects of thought	'Truth, reality, and sensation are identical'	?

however, it would enable the biosemiotic outlook behind the Baltic biologist Jacob von Uexküll's theory of Umwelt in 1909, wherein

> all animal subjects, from the simplest to the most complex, are inserted into their environments to the *same degree of perfection.* The simplest animal has a simple environment; the multiform animal has an environment just as a richly articulated as it is.[182]

This approach, arising from comparative anatomy, would finally collapse the model of a Great Chain of Being for the field of theoretical biology, implicitly undermining a long-standing belief in human uniqueness. As Sully summarized in 1879, 'modern science is doing much to upset this view of the animal world so flattering to man's self-conceit'.[183] Culturally, it was a different matter. Habits of thought enabling the 'aural machine' and its mechanisms of exclusion meant that the hierarchy of Being was undermined but not dismantled. The lessons of comparative anatomy undoubtedly roused some scholars into wakefulness, but for most, the 'anthropological sleep' would endure a while longer.

[182] Jacob von Uexküll, *A Foray into the Worlds of Animals and Humans*, trans. by Joseph O'Neil (University of Minnesota Press, 2010), p. 50; emphasis added. Cf. Uexküll, *Theoretische Biologie* (Paetel, 1920).
[183] Sully, 'Animal Music', p. 605.