Brainmedia

One hundred years of performing live brains, 1920–2020

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3. Demonstrating Brainwaves Beyond the Laboratory: EEG as White Magic and Dark Media, 1934–1941

> Having an electroencephalogram made of your mental processes is about as simple and painless as having your picture taken. At a recent demonstration to scientists in Detroit, a number of men volunteered to be "human guinea pigs" and, apart from some embarrassment at being part of the show, seemed to enjoy the experience.[1]
>
> — Jane Stafford, reporting for *Science Service, Arizona Republic*, June 30, 1935

In the Introduction, I described the 1934 demonstration in a Cambridge University lecture hall in which physiologists Edgar Adrian and Brian Matthews demonstrated, on stage and directly for an audience, a new machine for what would soon be called electroencephalography (EEG), recording the living brain's electrical pulses from the scalp. The *Nottingham Evening Post* reported about the discoveries of the two British physiologists as an "uncanny achievement" that would "open up immense possibilities and will, it is hoped, enable scientists to 'see' the brain working."[2] After 1934, the development of EEG snowballed in research laboratories in the USA and Europe, especially after Adrian toured several countries with lectures about the new technology.[3] Soon EEG also started to capture the attention of the public, as scientists actively sought to demonstrate the new technology beyond the laboratory.

In this chapter, I study this new technology's emergence from Adrian's first demonstration in 1934 to the publication of the first *Atlas of Encephalography* in 1941 and the first Hollywood portrayal of a brainwave reader, particularly examining the public manifestation of EEG as a technology in the making. I analyze different ways in which scientists and science communicators demonstrated and articulated this emerging research technique and the new phenomenon of seeing "the brain at work," as the *Nottingham Evening Post* put it.[4] This helps contribute to a better understanding of an under-examined part of the history of the EEG's establishment as a research technique: measuring living brains beyond scientific laboratories and lecture halls. I particularly focus on three kinds of EEG performances: demonstrations of the technology recounted in newspaper and journal articles in the 1930s, the first exhibition of electroencephalography to a

[1] Jane Stafford, "Science Takes a Look at Your Brainstorms," *Arizona Republic*, June 30 1935.
[2] "'Seeing' the Brain at Work. Specialists' New Aid to Diagnosis. Important Discovery," *Nottingham Evening Post*, December 01 1934, 8. The newspaper report was prompted by yesterday's lecture by Sir F. Gowland Hopkins in an address at the Royal Society, where Adrian received a medal. "Research on these remarkable lines is a yet new, and striking developments may be expected."
[3] In 1934, Adrian not only visited the conference of Electro-Radio-Biology in Venice, for example, but also a number of American universities.
[4] "'Seeing' the Brain at Work. Specialists' New Aid to Diagnosis. Important Discovery," 8.

broad audience at the Paris International Exposition in 1937, and the first appearance of a brainwave reading device in a mainstream Hollywood film in 1941. I trace EEG through these different spheres to show how visions of an active brain – and the hybrid setups of oscilloscopes, electrometers, zig-zag lines, screens, and subjects that produced them – were newly framed through such changing medial contexts.

The brainmedia I describe in this chapter are the special assemblages of fluctuating, experimental EEG setups and the particular media formats through which knowledge of the active brain is performed. It is in and through these brainmedia that EEG's conception was shaped between 1934 and 1941 in the interplay between scientists and science communicators. For my analysis I am particularly interested in tracing the ambiguities and negotiations between scientific validity and popular fascination that shaped these EEG performances. On the one hand, EEG demonstrations such as those of Adrian and Matthews were clearly meant to establish authority and scientific legitimacy for the proposition that regular patterns of electrical activity could be measured from the human scalp and for EEG as a new technology to do so. On the other hand, studying the articulation of EEG in articles, exhibitions, and films also reveals presentations of recorded brainwaves as strange or wonderful entities (brainwaves as unexpected visible presences of what is usually invisible) and as prompts for speculation (about the future possibilities of thought-recording or mental profiling, for example).

In this chapter, I trace both this boundary work between science and spectacle, and the (permissible) forms of fascination that were invoked by EEG performances. How were audiences envisioned to make sense of the newly visible "invisible" phenomenon of brainwaves? How were they asked to wonder about, or question, this uncertain technology? The different forms of fascination were tied, I argue, to the evocation of liveness in the EEG performances. I discern an oscillation between (what Tom Gunning has called) the "optical uncanny," associated with older imaginaries of brainwave media, and a new understanding of EEG as a particularly modern magic since the 1930s. Practices of performing the brain at work invoked, in the examples I show, ambiguous forms of liveness, interpretations that could waver between the 'liveliness' of scientific demonstrations (to be life-like, direct and vivid) but also the strange 'aliveness' of the scientific phenomena on display.

In probing these issues, I draw on historical scholarship concerning public scientific demonstrations and international exhibitions that showed modern novelties such as x-rays, cinematography, and electro-technological displays, a body of work (mostly focused on the era from the 1880s to the 1920s) that has been interested in the dynamics of scientific performance and the enactment of scientific spectatorship. Historian Tom Gunning, in this context, offers

important analyses of the modes of reception of modern technological inventions at world fairs around 1900.[5] As Gunning notes, at international expositions "not only the products of modernity were displayed but the protocols of modern spectating were rehearsed within the context of a new consumer culture."[6] He describes the way visitors could be interpellated by a "discourse of wonder," i.e. by the social repertoires, media communications, and exhibition designs that prompted a particular type of visitor experience – dazzlement, bewilderment, and astonishment, for example.[7]

Yet such discourses of wonder, and the experiences they call for, do vary. Ian Morus, studying Victorian science spectacles, has argued for a nuanced typology of different genres of performance for different "genres of science, carrying different epistemological and cultural messages."[8] In the late nineteenth century, new forms and sites for scientific performance mixed traditions from 'natural magic', academic science presentations, and illusionist theatre."[9] In doing so, these performances did not generate a uniform spectatorship of naïve, stupefied onlookers, but asked spectators to negotiate different sensibilities: knowing that part of performance was an act or illusion, for example; or appreciating a new technology's industrial ingenuity; or exhibiting what historian James Cook described as "a new, media-driven form of curiosity – perpetually excited, never fully satisfied."[10]

When new media technologies such as the x-ray and cinematography where on display or discussed in popular literature, commentators often actively invoked relations to the supernatural and the occult, presenting them as decidedly magical tools.[11] In tandem, the audience's encounter

[5] Tom Gunning, "Re-Newing Old Technologies: Astonishment, Second Nature, and the Uncanny in Technology from the Previous Turn-of-the-Century," in *Rethinking Media Change: The Aesthetics of Transition*, ed. David Thorburn and Henry Jenkins (Cambridge, Mass: MIT Press, 2003), 40.

[6] "The World as Object Lesson: Cinema Audiences, Visual Culture and the St. Louis World's Fair, 1904," *Film History* 6, no. 4 (1994): 424.

[7] "Re-Newing Old Technologies: Astonishment, Second Nature, and the Uncanny in Technology from the Previous Turn-of-the-Century," 45.

[8] Morus, "Placing Performance," 776; "Worlds of Wonder: Sensation and the Victorian Scientific Performance," *Isis* 101, no. 4 (2010): 810.

[9] Martin Willis, "On Wonder: Situating the Spectacle in Spiritualism and Performance Magic," in *Popular Exhibitions, Science and Showmanship, 1840–1910*, ed. Jill A. Sullivan (New York: Routledge, 2015); Tiffany Watt Smith, "Of Hats and Scientific Laughter," in *Staging Science*, ed. Martin Willis, Palgrave Studies in Literature, Science and Medicine (Palgrave Macmillan UK, 2016); Iwan Morus, "'More the Aspect of Magic Than Anything Natural': The Philosophy of Demonstration," in *Science in the Marketplace: Nineteenth-Century Sites and Experiences*, ed. Aileen Fyfe and Bernard V. Lightman (Chicago: Chicago University Press, 2007); Morus, "Worlds of Wonder."; Diarmid A. Finnegan, "Lectures," in *A Companion to the History of Science*, ed. Bernard Lightman (Chichester: John Wiley & Sons, 2016).

[10] James W. Cook, *The Arts of Deception: Playing with Fraud in the Age of Barnum* (Cambridge, MA: Harvard University Press, 2001), 68. Cited in Michael Saler, "Modernity and Enchantment: A Historiographic Review," *The American Historical Review* 111, no. 3 (2006): 711.

[11] Pamela Thurschwell, *Literature, Technology and Magical Thinking, 1880–1920* (Cambridge: Cambridge University Press, 2001); Roger Luckhurst, *The Invention of Telepathy, 1870-1901* (Oxford University Press, 2002); Maria Warner, *Phantasmagoria* (Oxford: Oxford University Press, 2019). Solveig Jülich, "Media as Modern Magic: Early X-Ray Imaging and Cinematography in Sweden," *Early Popular Visual Culture* 6, no. 1 (2008); ibid.

with these new technologies was itself framed as prompting an experience of "modern magic," as Rachel Moore notes in the context of discourses of early cinema spectators.[12] These observations on mixed affects and sensibilities on the part of the public are part of a body of historical scholarship on the fin-de-siècle period that nuances a dominant discourse of modern 'disenchantment', arguing instead that disenchantment, as Michael Saler and Simon During have emphasized, is always paired with striking new forms of "modern enchantment."[13]

While such genres of performance and elements of "modern magic" or "modern enchantment" have been well studied in relation to scientific and technological displays in the late modern period of the 1880s to the 1920s, there is considerably less scholarship analyzing how audiences in the USA and Europe were prompted to engage with new scientific displays of the body and the brain in the 1930s.[14] By that time, the landscape of science mediation had considerably changed and diversified. As mentioned in Chapter 2, new publication formats, magazines, radio shows, and (traveling) museum exhibits reached audiences of various levels of scientific understanding and interest. As various historians have recently argued, wonder takes on different forms in different circumstances, so it is vital to historicize the particular discourses of wonder.[15] The newly differentiated science communication of the 1930s thus requires historical studies to examine both the negotiations between science and its publicness and the varying modes of reception across different sites and genres.[16]

To do so, this chapter in divided in four sections. The first tackles the era prior to the emergence of EEG, around 1900, when the conception of an all-pervasive sphere of undulating waves allowed for interacting imaginations of thought-particles and technological media to capture them. When communicating about the new technology of EEG, after 1929, scientists and science communicators needed to negotiate these long-established brainwave imaginaries. By sketching a new landscape of science communication, I showcase the 1930s' more heterogeneous field of performing knowledges that harbored ambiguous framings of EEG. I also show how drawing a rigid divide between performative practices of "serious" scientists and "popular" science

[12] Rachel O. Moore, *Savage Theory: Cinema as Modern Magic* (Durham: Duke University Press, 2000), 2.
[13] Simon During, *Modern Enchantments* (Harvard University Press, 2009); Saler, "Modernity and Enchantment."; Jason A. Josephson-Storm, *The Myth of Disenchantment: Magic, Modernity, and the Birth of the Human Sciences* (Chicago: University of Chicago Press, 2017).
[14] Saler, "Modernity and Enchantment," 711. For an example that extends further into the twentieth century, see Cartwright, *Screening the Body*.
[15] This call for the historicity of 'wonder' has been opened up by historians who have called attention to varying inflections of "cognitive passions" attached to objects and performances of wonder in scientific spheres. "Cognitive passions" in Lorraine Daston and Katharine Park, *Wonders and the Order of Nature, 1150-1750* (New York: Zone Books, 1998), 15.
[16] Arne Schirrmacher, "Nach Der Popularisierung. Zur Relation Von Wissenschaft Und Öffentlichkeit Im 20. Jahrhundert," *Geschichte und Gesellschaft* 34, no. 1 (2008): 83.

communicators is inadequate, and instead highlight the tropes and rhetoric the two shared. In the second section, I zoom in on American newspaper reports on EEG after its US introduction in 1934 and describe the characteristic reporting on EEG demonstrations, events that presented a vivid narrative to communicate an uncertain scientific phenomenon. I also reveal newspaper articles' ambivalence on EEG's "photographic truth": on the one hand, EEG graphs were rhetorically compared to photographs and movies to strengthen their technological objectivity; on the other hand, readers were also asked to be critical and distinguish between modern records of mental activity and old fantasies of thought-recording. Section three studies EEG demonstrations at an international science exhibition in 1937. Central here is a discourse on *mystique populaire* or "white magic" – a spectacular presentation of science that was framed within a new emphasis on specialized and expert science. In the last section, I discuss the return of the uncanny in the portrayal of a fictional brainwave reader in the 1941 Hollywood film *The Devil Commands*. I suggest that this hyperbolic presentation asked its viewers to skeptically examine and tentatively critique the scientific certainty and optical objectivity of brainwave science.

Ultimately, this chapter shows how particular forms of liveness in science demonstrations present ambiguities that crisscross between different genres of circulating knowledges and performances of science, between the work of nerve scientists and a new sphere of professional science communication. EEG performances in this period are characterized by oscillating positions between establishing scientificity and invoking wonder, between debunking myths and conjuring speculative futures.

Brainwave imaginaries and popularizing science

When Hans Berger first published his experimental results in 1929 on what he called a "brain mirror," the technology measuring whole-brain nerve activity and the idea of the electrically patterned brain were not readily accepted in scientific circles.[17] In established EEG histories, it is the 1934 demonstration by eminent and Nobel-prize winning physiologist Edgar Adrian that offered the necessary stamp of approval for this technological setup and allowed the concept of patterned whole-brain activity to become a scientific fact.[18] Yet while members of the scientific community were initially doubtful, Berger's publications hit popular newspapers like a bomb. As

[17] "Hirnspiegel" in Berger, Hans, [16 November 1924, IV, p. 164], cited in Borck, *Hirnströme*, 58. Cornelius Borck and David Millett have traced the complex coming into being of EEG as a technology and offer a number of reasons for the initial rejection of Berger's discovery, including EEG's inconsistency with reigning theories of nerve mechanisms and Berger's affiliation with the terrain of psychophysiology (rather than neurophysiology). Ibid.; Millett, "Wiring the Brain: From the Excitable Cortex to the Eeg, 1870-1940," 326. See also Adrian's own account of the initial obscurity of Berger's discovery: Adrian, "The Discovery of Berger."

[18] Millett, "Wiring the Brain: From the Excitable Cortex to the Eeg, 1870-1940," 310.

Cornelius Borck recounts, in the summer of 1930, numerous articles reported on Berger's research with bold headlines such as "The Electric Script of the Brain," "The Zig-Zag Curve of the Human Mind," "Making Thoughts Visible," "Electricity Brings All to the Light of Day—Finally We Learn What's Going on Inside Our Brains," "The Electrical Record of Thoughts," "Electrical Brain Script," "The Machine That Reads Thoughts," "The Electrical Thought-Reader."[19] Newspapers eagerly printed the graphic records of Berger's original article without much further explanation; the images functioned as conclusive visual proof of a new, electro-technically produced visibility – not only of the brain, but also of the human psyche.[20]

Popular reporting on EEG followed what Borck calls a "seductive story pattern," that presented it as a type of thought-recorder noting down the brain's natural script.[21] This story pattern tied into a long-imagined existence of cerebral radiations and the understanding of the brain as a space permeable to, and populated by, some type of thought-related energetic particles that were potentially perceptible.[22] Long before Berger published on brain rhythms in 1929, literary imaginations of, and material experiments with, thought-reading helmets, cerebroscopes, and telepathic radiations shaped ideas about the potential visibility of human thoughts. Around 1900, numerous physiologists, (para-) psychologists, and engineers had claimed the existence of mental radiations emanating from the brain, while at the same time, in fiction, the concept of neurophotography or mindscript became a literary motif.[23] Within this brainwave universe, the development of technological media, imaginaries of thought-reading phenomena, and conceptions of the nervous system were reciprocal and co-emergent. Historians of science have studied cases of "vibratory photography," "psychic television," "psychic radio," and "spiritual wireless" to show that (new) media were shaping the imaginary of capturing the human psyche but were also significantly shaped *by* it; as Stefanos Andriopoulos puts it, "one rendered the other imaginable."[24]

[19] Borck, *Brainwaves*, 112.
[20] Ibid.
[21] "Electricity as a Medium of Psychic Life: Electrotechnological Adventures into Psychodiagnosis in Weimar Germany," *Science in Context* 14, no. 4 (2001): 584.
[22] On resistance to these imaginaries, see Sabine Haupt, ""Traumkino.' Die Visualisierung Von Gedanken: Zur Intermedialität Von Neurologie, Optischen Medien Und Literatur," in *Das Unsichtbare Sehen*, ed. Sabine Haupt and Ulrich Stadler, Edition Voldemeer (Springer Vienna, 2006), 117. (n.144).
[23] John Durham Peters, "Broadcasting and Schizophrenia," *Media, Culture & Society* 32, no. 1 (2010). As Anthony Enns and Shelley Trower point out in their cultural history of 'vibratory modernism', the interpretation and scientific understanding of vibrations at the turn of the century was frequently conceived of as a form of energy that was underlying a type of unconscious, pre- or non-linguistic communication. A. Enns and S. Trower, eds., *Vibratory Modernism* (London: Palgrave Macmillan, 2013); Haupt, ""Traumkino.' Die Visualisierung Von Gedanken: Zur Intermedialität Von Neurologie, Optischen Medien Und Literatur."; Littlefield, *The Lying Brain.*
[24] Stefan Andriopoulos, "Psychic Television," *Critical Inquiry* 31, no. 3 (2005): 636; Anthony Enns, "Vibratory Photography," in *Vibratory Modernism*, ed. A. Enns and S. Trower (London: Palgrave Macmillan, 2013); Richard Noakes, "Thoughts and Spirits by Wireless: Imagining and Building Psychic Telegraphs in America and Britain, Circa 1900–1930," *History and Technology* 32, no. 2 (2016); Anthony Enns, "Psychic Radio: Sound Technologies, Ether Bodies and Spiritual Vibrations," *The Senses and Society* 3, no. 2 (2008).

Various modern imaginaries of brainwave media in the fin-de-siècle focused on what various authors have described as technology's uncanny character: i.e. its boundary-crossing ability to traverse time and space and animate the dead.[25] Brainwave media offered a particularly special combination of, on the one hand, the magical and eerie capabilities attributed to modern recording and transmission media, and, on the other, the elusive realm of thoughts and the impenetrable space of the skull. Hence, fantastic brainwave-media were doubly uncanny, combining the obscurity of the brain with the disorienting and supernatural powers attributed to modern media. At the turn of the century, this technological uncanniness was also an important resource in performing scientific and technological knowledge. Tom Gunning, in his analysis of world-fair displays of new technologies around 1900, argues that it is ultimately the uncanny aspect that sustained visitors' astonishment and attraction to spectacles of technical innovation, even when such technologies had become fairly familiar.[26]

Tracing performances of nerve recordings in the 1920s and EEG in the 1930s reveals that the discursive shape of technology's uncanny – of the sensed potential for magical or unnatural powers – had gradually started to shift. As I will show below, scientists and science communicators persistently invoked a language and atmosphere of mystery and wonder, while at the same time actively questioning or even debunking this association with the supernatural (with telepathy, talking to the dead, or materializing spirits). This did not mean that evocative connections between nerve research and phenomena such as hypnosis, clairvoyance, and extrasensory perception vanished altogether (there were a number of conspicuous psychotechnical technical machines circulating in the 1920s that connected to parapsychological discourses), but that new understandings of electro-technical magic had become available.[27]

Brainwave technologies could now be marvelous but not supernatural; they could be magical in a new, modern, technologically and scientifically supported way. In the 1920s, science reporters negotiated this modern type of magic with the older uncanny, and did so in new spheres and genres of popular science communication. A telling example in this respect is a full-page article in a 1926 American newspaper with the headline: "Why Radio May Have Uncovered a Sixth Sense!

[25] On the technological uncanny, see Laura Mulvey, *Death 24x a Second: Stillness and the Moving Image* (London: Reaktion Books, 2006), 27; Gunning, "Re-Newing Old Technologies: Astonishment, Second Nature, and the Uncanny in Technology from the Previous Turn-of-the-Century."

[26] "Re-Newing Old Technologies: Astonishment, Second Nature, and the Uncanny in Technology from the Previous Turn-of-the-Century."

[27] In *Brainwaves*, Borck describes the popular attention and early popular descriptions of EEG as fitting with the already established public presence of remarkable psychotechnical machines in the 1920s – such as diagnoscopy, electro-therapy, or thought-radio – that promised to re-energize bodies, read a person's character, find a suitable vocation, or broadcast thoughts. Borck, *Brainwaves*, 76-121.

Science Now Investigating Cases of Broadcast Programs Being Picked Up, Unaided, by the Human Nervous System."[28] [Figure 3.1]

It recounts how American radio engineers had started to research the possibility that modern humans (living in contemporary, media-saturated atmospheres) would develop a "sixth sense" or "radio sense" which would allow the nervous system to directly pick up radio broadcasts. This was not a supernatural development, as the article makes clear, but a case of natural evolution, a type of neuro-technogenesis. The article strengthened the veracity of this fantastic, yet entirely scientific development by noting the fact that in Europe, various scientists "had managed to pick up 'brain waves' being broadcast by the nervous system through the medium of a modified radio site."[29]

The article is typical of a new type of popular-science reporting in newspapers at the time, created by the growing newspaper syndicates that circulated their features in multiple newspapers.[30] These articles typically presented their readers with an amalgamation of discoveries. In this case, the article connected, with a grand sweep, the elusive work of an unknown American radio engineer with Adrian's nerve recordings, as well as the work of Italian parapsychological researcher Fernando Cazzamalli (whose research into telepathic brainwaves with super-sensitive radio had been a recurrent favorite topic for popular-science features, though received with much suspicion by various scientists).[31] Popular-science reporting in the 1920s thus rhetorically united these disparate spheres in a common universe of electro-technological circuits and waves. Such brain–radio connections were intuitively and speculatively produced in the text and by a photomontage-

[28] "Why Radio May Have Uncovered a Sixth Sense! Science Now Investigating Cases of Broadcast Programs Being Picked up, Unaided by the Human Nervous System," *The Indianapolis Star*, 4 July 1926.
[29] Ibid. The article referred to the work of Ferdinando Cazzamalli, *Archivio generale di neurologia, psichiatria e psicoanalisi* 4 (1925); P. Lasareff, "The Theory of Nervous Activity," *Science* 59, no. 1530 (1924); Adrian, "The Impulses Produced by Sensory Nerve Endings."
[30] Patrick Scott Belk, "King Features Syndicate," in *Comics through Time: A History of Icons, Idols, and Ideas*, ed. M. Keith Booker (Santa Barbara, CA: ABC-CLIO, 2014), 218. The brain radio piece was by the well-known *Newspaper Feature Service*. See Cynthia Denise Bennet, "Science Service and the Origins of Science Journalism, 1919-1950" (Iowa State University, 2013).
[31] Another example of reporting on Cazzamalli, see "Radio to Solve the Secrets of Telepathy. How Science Seeks to Show That 'Brain Waves' Transmit Thoughts and Find a Way to Talk with the Dead," *Daily Press* (1925). On Cazzamalli's popular yet contested research in the 1920s and 30s, see Borck, *Brainwaves*, 100.

Why Radio May Have Uncovered A Sixth Sense!

Science Now Investigating Cases of Broadcast Programs Being Picked Up, Unaided, by the Human Nervous System.

Several Instances Have Been Reported to the Radio Engineers of Station WJZ (Shown at Right) of Persons Miles Away Clearly Picking Up Snatches of Their Programs Without the Use of a Man-Made Receiving Set.

Right: Hollywood McCosker, Radio Director of Station WOR, Who Is Conducting Numerous Experiments in an Effort to Prove the Theory That the Human Nervous System Is Receptive to Radio Waves.

A SIXTH sense has at last been discovered, according to many prominent scientists.

It is that of human radio receptivity. And scientists of both Europe and America have gathered a mass of evidence to prove their theory that radio broadcasting can be "picked up" by many persons without any radio set other than their own nervous systems.

While such a theory would, a few years ago, have been held untenable, and while a number of the more conservative authorities still wait for further proof before accepting it, a mass of both empirical and laboratory evidence has been gathered by the radio engineers working on the problem.

Scientists first became interested in the possibility when numbers of the broadcasting stations reported that people had written a to them stating that they had picked up faint fragments of the programs without having their radio sets turned on, when in other rooms than those in which their sets were located, and in some cases the phenomena were reported by persons who did not even own radio sets and had no interest in broadcasting.

The hypothesis was then formulated that just as a person's eyes are receptive to light waves, his ears receptive to sound waves, his skin sensitive to heat waves, it is quite possible that some unknown sixth sense is receptive to radio waves. This was given further weight by the almost simultaneous report of well-known scientists in England, Italy and Russia that they had managed to pick up "brain waves" being broadcast by the nervous system through the medium of a modified radio set.

Among the larger radio broadcasting stations in America that have received reports from persons claiming to have picked up bits of their programs without radio receiving sets are Stations WJZ, WOR and WMCA. While all of these are located in the immediate vicinity of New York City, it is pointed out that it is there, if anywhere, that impulses would be picked up without artificial aid, because of the congestion of broadcasting and the fact that the ether is jammed with high frequency waves of a great variety of lengths.

Station WOR, which has always taken a leading part in the audion experimental work now being carried on in the country, has also conducted extensive investigations into this particular phase of radio phenomena. More than sixty persons believing themselves to be mentally receptive to broadcasting have reported the fact to that station. And Mr. Hollywood McCosker, director of Station WOR, has personally superintended the investigations being carried on by that station's engineers and laboratory.

According to Mr. McCosker, many of the people that have reported to the station and who have been investigated are radio experts. They are able to discuss their sensations in a technical manner and are scientifically interested in arriving at the real solution.

It is with such cases as these that Mr. McCosker is conducting his experimental work. Some of them report that they have heard parts of programs clearly, the extracts that they gave as examples, upon being checked, having been found to correspond with the broadcasting schedule. Others reported the phenomena had occurred in an intermittent fashion while they were at great distances from the broadcasting source. One aged woman, with no interest in radio, but who lives in the immediate neighborhood of the station, wrote in to complain that in certain weather the broadcasting interfered with her sleep. Jean Montgomery, of New York City, reported that she was even able to dance at times to the music she heard.

The work being done under Mr. McCosker's supervision leads him to believe that this strange receptivity has nothing to do with such well-known psychological phenomena as hypnotism and telepathy. He believes the solution is far simpler.

There are many sounds of lower and higher vibration that the human ear, or at least the average human ear cannot detect. Science, however, has discovered many persons who have some curious quirk in their hearing apparatus which permits them to hear sounds, too shrill or too deep for the average ear. Mr. McCosker points out that it is reasonable to suppose that some persons have a nervous system tuned especially sensitive to radio waves which permits them to pick up broadcasting in the same way that the exceptional person alone can catch notes too high on the musical scale for the average ear to register.

On the other hand the vibration of light waves, Mr. McCosker points out, is far more rapid than that of sound waves. And between the comparatively slow sound waves and the immensely rapid light waves, there is a vast middle ground. And it is very significant, he believes, that the vibration of radio waves in broadcasting comes in between these two extremes of human perception. If the human nervous system can pick up the slow sound waves and the ultra-rapid light waves, it is reasonable to suppose that it may be sensitive in some measure to radio waves.

Other scientists working on the problem argue that just as the sense of hearing has developed an especially tuned organ for reception in the ear, and as the eye has been developed to record light waves for the nervous system, so man may likewise have developed in some sixth sense, which as yet is undefined in most persons, but which will eventually, through generations of broadcasting, become practically universal.

It is concerning the character of this sixth or radio sense that much of the scientific argument is now carried on. That it is physiologically a simple organ is admitted by all sides. The human body has many elaborate counterparts to the man-made radio receiving set that, if Nature so intended, could be easily turned to the reception of radio waves.

It has long been known that the human body can act as an aerial, because of its conducting properties and large surface area. The problem of the interception of the radio waves is therefore explainable in much more simple manner even than the way the eye or ear intercepts light and sound waves.

It has also been long an accepted theory that the nerves transmit messages from the sensitory points such as the eyes, ears and skin up to the brain in the form of electrical impulses. It is therefore quite possible that radio waves, intercepted by the body acting as an aerial, would be transmitted up to the brain by the nervous system, in the same way that sound, light and heat waves are transmitted.

But scientists have been unable to reach any commonly accepted conclusion as to what takes place when the radio wave reaches the brain and how it is transformed into sound perception. But then, they have never been able fully to understand how sound or light waves are transformed into brain perceptions either.

The human brain is made up of more than 9,000,000,000 tiny cells which take charge of man's thinking, imagination, memory perception and other activities. They act as transformers, amplifiers, transmitters and resistances. Just exactly how they do their work, science has never been fully able to discover. But that they manage to accomplish this vast work, everyone now admits, and that under the right circumstances, they are able to transform radio waves into perception, scientists now believe. Therefore the scientists merely call it a sixth sense, or radio sense and after a little argument, let it go at that.

While up till recently much of the investigation along this line was theoretical, some astounding discoveries have taken place in the last year that place the theory on quite a different basis. Almost at the same time Professor Ferdinando Carnamilli, of the University of Milan, Professor Peter Lazareff, Director of the Physical Institute of Moscow and discoverer of the Ionix theory of stimulation, and Dr. E. D. Adrian, physiological authority of Cambridge University, England, announced that by using elaborate radio apparatus they had tuned in on brain waves; that is, picked up messages broadcast by the brain out along the nervous system of the body.

To be sure this is the reverse of the line along which American scientists are working. The European scientists have proved that the brain broadcasts electrical messages which may be picked up by a radio receiving set. The American physiologists claim that radio waves broadcast by a man-made broadcasting station can be picked up by the human brain acting as a radio set.

By necessity, much of the American research work along this line is empirical. Laboratory instruments cannot be applied to the human brain to measure just what impulses are being received and how the radio waves are transformed into thought perception. But the European scientists, working from the other direction, have been actually able to demonstrate their premise. Isolating the nerve of a frog's muscle, by means of the capillary electrometer and the electron tube, the message passing along the nerve from the muscle to the brain and vice versa, may be intercepted and amplified to tremendous ascertainable proportions.

One other theory has gained consideration in America to account for the radio receptivity of certain persons. According to Mr. Charles Willis, New York radio engineer, who has done much of the pioneer work along this line, the explanation is as follows: Radio and light waves are of the same character and merely differ as to length. First come radio waves, then a gap, then heat waves, then light waves and then the invisible ultra-violet and X-rays. It is in this gap below the five-meter radio wave length familiar to the short wave experimenters that Mr. Willis believes the secret lies.

The sound being broadcast by an orchestra is transformed into radio waves. Somehow in the mysterious gap the radio waves may be superimposed on light waves. Several examples of such a phenomena have already been reported, one outstanding instance being the case in Birmingham, where radio fans reported picking up fragments of conversation that seem to have been broadcast by a 2,000,000-candle-power searchlight. Once superimposed on the light waves, the radio wave enters the eye and being the same type of wave stimulates the perception centers of the brain in the same way that light does.

"If we can accept such instances of radio waves being transmitted by light waves as facts, and I see no reason to doubt the unbiased reports coming from Birmingham and other centers, it offers us a very workable basis for our solution of the radio sense," states Mr. Willis.

"The light waves varying according to the broadcast radio variations, will enter the nervous system perhaps through the eye, proceed upward to the brain centers and then be transformed into perception probably through a process very similar to that employed by the man-made photo-electrical cell."

Just what this sixth or radio sense, if an actuality, will mean to the world, scientists refuse to prophesy. Like every other sense, it will only become universally developed after generations of use. Whether it will then become a tremendous medium of world-wide communication, whether one will be able to enter into radio communication with anyone else in the world by merely focusing the radio sense in the same way that mankind now focuses his eye or his brain on a problem, is a field too vast for even the scientists who now believe in this sixth sense to comment upon.

Above: An Anatomical Reproduction of the Brain, Showing the Basal Aspect, With Its Nine Billion Cells and Maze of Nerves and Arteries, Which Science Claims Is Possibly the Main Part of the Human Radio Receiving Set.

Below: Miss Marion Talley, the Child Wonder of the Metropolitan Opera Company, Broadcasting at Station WJZ.

Miss Jean Montgomery, of New York, Who Claims That Though She Has No Radio Set She Can at Times Receive Broadcast Musical Programs Clearly Enough to Dance to the Music.

Figure 3.1 Why Radio May Have Uncovered a Sixth Sense!, 1926 (newspaper article)

technique that evocatively superimposed and combined illustrations of brains, zig-zagging radiations, and radio equipment, thus visually materializing this brain radio on paper.

It was this heterogeneous and ebullient popular-science reporting, with its amalgamations of supernatural and electro-techno-scientific magic, that set the tone for the seductive story pattern of Hans Berger's discoveries of a "brain script" and "thought-reader" in 1929. Berger himself was uncomfortable with what he saw as journalists' overly speculative reporting on his work. As Borck recounts, Berger refused further inquiries for information on his discovery and the corresponding graphs, even to the *New York Times*.[32] Similarly, Adrian remarked that his 1934 brainwave publications and demonstrations – described as uncanny by at least one reporter – had been spellbinding to such an extent that many newspapers and journals covered the story "with varying degrees of accuracy," as it appeared "the temptation to write about brain waves was too great to be resisted."[33]

This picture of the reluctant academic researcher versus the over-imaginative reporter is a well-known one befitting the self-fashioning of the serious scientist in the early decades of the twentieth century. Yet, this image deserves further scrutiny and nuance. By the 1930s, science popularization had become an institutionalized practice in many countries: to be involved in representing science and participate in some form of promoting science had become an integral part of many researchers' scientific work.[34] Nerve researchers often actively participated in the interwar science communication that framed life as newly animated by electro-technology (a world I have described in Chapter 2 in relation to Fritz Kahn and the ensuing luminous and motograph brains). Neurophysiologists in the 1920s made use of a range of equipment – telephones, loud-speakers, phonograph records – to translate nerve records to students and broader audiences.

With these technological setups, they were much invested in developing an attractive demonstration aesthetic that would convey experiments vividly. One reporter, for example, described what he saw at a 1926 neurophysiological gathering (a meeting that included Adrian's demonstration of the first sensory nerve recording by light-projections of graphic records and sounds played from a phonograph), as "some of the most beautiful experiments of the past years."[35] These vivid demonstrations were very amenable to press coverage: in 1928, US newspapers announced a radio broadcast by the Iowa psychiatrist Lee Travis, who studied the effect of fear, excitement, and alcohol on the nerve centers and would allow listeners to hear the

[32] *Brainwaves*, 112.
[33] Adrian, "The Discovery of Berger."
[34] Bensaude-Vincent, "In the Name of Science," 324.
[35] "Mödosam Onsdag for Fysiologer Och Försöksdjur. Efter Dagens Hundra Föredrag Ger Stockholms Stad Bankett I Gyllene Salen," *Dagens Nyhter*, 5 August 1926. "Listening-in to the Nerves: Dr. Adrian's Experiments," *The Observer*, March 28 1926.

"rat-a-tat sound" of the human brain at work.[36] Similarly, in the UK, Adrian's colleague Brian Matthews spoke about nerve research in a series of broadcast talks in 1930 (later published in a popularly oriented book entitled *Electricity in Our Bodies*) in which he described the human body as permeated by invisible currents not unlike wireless radio waves, that could be made similarly perceptible. And Adrian himself also engaged in public scientific events: one year after his demonstration of brainwave measurements, for example, he would again lecture on EEG as part of an annual popular exhibition by the Royal Society at the Burlington House, an event "for entertainment and instruction," as the *London Times* reported, that included, amongst other things, a driving simulator, x-ray cinematographic films, and examples of new electro-cardiographs.[37]

These examples all signal the necessity of a more nuanced image of (nerve) scientists as partaking in a growing practice of science communication that was an integral part of scientific work. A particular emphasis on the liveliness or vividness of demonstrations was shared between different spheres in which science was performed. What becomes visible is a more heterogeneous field of scientific performances and communications by scientists and science communicators invested in attracting attention to scientific research and developing vivid forms of engagement. In the next three sections, I typify the characteristic and novel forms that new EEG research took in this emerging sphere of science communication. Brainwave imaginaries persisted, as did the boundary work between the supernatural and modern magic, but these dynamics took on different forms in varying medial contexts.

Framing EEG in print: vivid demonstrations and "the stuff that dreams are made on"

After Berger and Adrian's demonstrations of brainwaves in 1934, EEG research developed into different directions in local research communities (predominantly in the USA, France, and Germany), ranging from EEG as diagnostic tool for epilepsy research to investigations into the underlying physiology of the brain's electrical activity.[38] The rapid discovery of EEG's applicability in diagnosing epilepsy, one year after Adrian's demonstration, strengthened the sense that EEG was a tool of great promise. Yet, throughout the second half of the 1930s, EEG research was characterized by a "peculiar epistemological status," as historian David Millett puts it. There was no solid grasp of the underlying causes of brainwave patterns, and there was only general and

[36] "Pattern of the Brain at Work to Be Broadcast by Wsui," *Wilmington Morning News* (1928).
[37] "Driving Tests Indoors," *The Times*, 4 June 1935.
[38] Cornelius Borck, "Between Local Cultures and National Styles: Units of Analysis in the History of Electroencephalography," *Comptes Rendus Biologies* 329, no. 5–6 (2006).

provisional agreement on what constituted a "normal" measurement – "EEG remained a phenomenon in search of its significance."[39]

Though the underlying physiology of the brain's activity patterns was hardly understood, what emerged was a bustling practice of correlating EEG measurements to find the characteristic curves of people with schizophrenia, criminal delinquents, misbehaving children, and intoxicated subjects, as well as a search for the EEG markers of different personality types, gender differences, and intelligence levels.[40] American researchers had particularly rapidly taken up EEG research after 1934, a fact that Borck and Millett also attribute to the USA's greater availability of, and expertise with, electronic amplification technology that could be drawn on, as well as its generous funding for neurology research.[41]

American newspaper reports about EEG from the mid-1930s are evidence of the enthusiasm for this new technology, yet also of the uncertainty about EEG's meaning that science communicators needed to navigate. At the same time, the mid-1930s saw the emergence of the first full-time science-news reporters catering to American newspapers and magazines who also formed new professional associations.[42] These science-writing associations not only claimed to benefit the better education of humankind, but emphasized their assistance to scientists in painting a better image for science, one that would help them secure more government funding.

Within this new landscape of mediating science, new exchange structures between scientists and science reporters emerged: reporters were actively invited to scientific meetings; lectures were mailed to reporters in advance; and universities started to hold press conferences.[43] Increasingly, professional scientific meetings – which often included exhibitions and demonstrations – became suitable events for reports about scientific developments. In American nerve research (a field characterized by a particularly competitive funding environment) EEG demonstrations were vehicles for laboratory teams to show their scientific expertise and technological prowess. At the scientific exhibit of the 1936 meeting of the American Medical Association in Kansas City, for example, a team of Harvard researchers used an actual epilepsy patient to demonstrate the

[39] Millett, "Wiring the Brain: From the Excitable Cortex to the Eeg, 1870-1940," 406.
[40] Borck notes that it was the success of EEG in diagnosing epilepsy in the 1930s that sparked the high hopes for applying EEG as an objective tool to classify other pathological conditions, as well as the brainwave characteristics of normal subjects.
[41] Borck, "Between Local Cultures and National Styles."; Millett, "Wiring the Brain: From the Excitable Cortex to the Eeg, 1870-1940," 408-11.
[42] Bennet, "Science Service and the Origins of Science Journalism, 1919-1950."; David Dietz, "Science and the American Press," *Science* 85, no. 2196 (1937).
[43] The Harvard Tercentenary celebration in 1936 is a characteristic example in this respect. David Dietz' comments (as president of the National Association for Science Writers) also show the opening up of a new science–journalism relationship, where the professional science writer could counsel the scientists: "the best advice that I can give you is that you play that you are a newspaperman when you write the abstract of your paper. Make it a condensed statement of your paper with all the important facts in it" "Science and the American Press," 111.

capability of an EEG machine to reveal small epilepsy fits in the brainwave record.[44] While the fits were unnoticeable to the subject, they would become visible for the exhibition visitors. Science reporters jumped on such mediagenic demonstrations, which presented newsworthy scientific occasions and provided newspaper readers an attractive entry into a new and equivocal phenomenon.

In 1935, at the meeting of the Federation of American Societies for Experimental biology, a team of Harvard researchers demonstrated the EEG at Detroit's Henry Ford hospital, inviting members of the press to observe and participate. The *New York Times* featured a front-page article on this demonstration with the headline "Electricity in the brain records a picture of action of thoughts."[45] In the article, the *Times'* science reporter recounts how he offered himself as a guinea pig, taking part in the mental tasks the scientists assigned him. He describes the "tense silence of the room" while his mental processes generated tiny electrical currents, "such stuff as dreams are made on," that could now be recorded on a long roll of white paper. Unfolding the course of the experiment to his readers – sitting in a chair, applying the electrodes, hearing the commands of the researchers (multiply 32 by 21), and seeing the changing wave-patterns on the recording paper – the author invokes an atmosphere of suspense and anticipation, while at the same time framing this excitement within the arc of a scientific experiment that the reporter witnessed directly.[46]

Casting a story about electroencephalography in the narrative of a personal encounter, and thus emphasizing the author's own participation, evoked an intimate and more direct engagement between the reader and the scientific setup. The reporter's personal account added experiential substance, drawing the reader into what was described as a pioneering and uncertain situation. With a similarly direct and engaging style, *Popular Science Monthly* ran a field report on EEG ("these mysterious currents") prompted by a meeting of sixty "'brainwave' experts" at the Loomis EEG laboratory in New York, as well the reporter's personal visit to Louis Max' EEG laboratory at NYU.[47] The piece turns to direct address when it asks the reader to "follow Dr. Max into the dimly lighted instrument room" and "imagine yourself behind the scenes in his basement brain-wave laboratory." Reading the article, the reader would traverse the magazine's pages, encountering

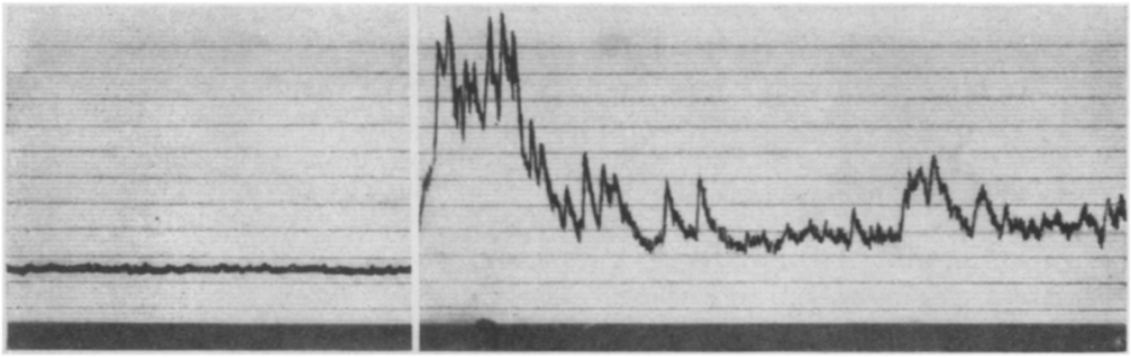
[44] William Laurence, "Brain Records for Diagnosis," *New York Times*, May 15 1936.
[45] "Electricity in the Brain Records a Picture of Action of Thought," *New York Times*, April 14 1935.
[46] Ultimately, the story ends in a true revelation by the machine, since the device disclosed something that most spectators could not have gauged: a short "thought-wave" is displayed after the author has given his response, explained by the scientist as a quick recalculation of the problem, an expression of the author's doubt at his own, initial answer. Together, the scientist and his new device had exposed the writer's hesitance, making visible to the spectators an otherwise private fact. The story thus endowed the mechanism of the electro-encephalogram with particularly agency and foretelling power, while simultaneously elevating the status of the scientist who had the ability to read the machine.
[47] Edwin Teale, "Amazing Electrical Tests Show What Happens When You Think," *Popular Science Monthly* 128, no. 5 (1936).

images of researchers dressed in white lab coats and of test subjects in intricate technological setups in which the readers themselves might one day be encased.

By mixing eyewitness accounts of experimental situations with adjectives full of wonder – "stuff of dreams," "magical," "mysterious" – these articles are expressive of the particularly modern magical attitude of these mediations of science, presenting images of wonderfully strange technology and science performances that always also emphasized scientific experimentation and direct observation. In science magazines and the newspapers' new science sections, accounts of EEG were characterized by this dual aspect, combining delight at the mystery of these new "telltale" visualizations and the suggestion of future visibilities of the mind with a simultaneous focus on the ingenuity of a technological setup revealing a previously invisible phenomenon. Throughout this discourse, the supernatural connotations of brainwaves were usually actively debunked – reporters assured readers there was nothing otherworldly or mystical to see. EEG's magical allure, reports suggested, was strictly due to its marvelous technological capacity of making visible the usually invisible.

The scientific status of technological magic becomes poignantly visible in the returning reference to the strikingly photographic-seeming measurements of sleeping subjects made by Louis Max. In May 1935, a *Science Service* reporter described the first presentation of these electromyographs at an evening event of the New York Academy of Sciences.[48] [Figure 3.2]
The article assures the reader that these are "not occult, not 'spirit' pictures," but that "the dream tracings were made with a practical hook-up of familiar electric apparatus, string galvanometer and amplifier." Printed next to the newspaper report was a "photograph made of a dream of Coney Island" which showed a flat line of peaceful sleep that turned into wildly spiking peaks when its subject had reportedly dreamed of the New York amusement park. A significant element of the graph's attraction was the striking juxtaposition it offered between seeing the famous fun fair – a cultural symbol of sensory excitement and excess – within the familiar and simple zigzagging line

[48] "Scientists See 'Dream Walking' with Chart Aid," *Berkeley Daily Gazette*, May 21 1935; "Photographic Record Made of a Sleeper's Dream," *The Science News-Letter* 27, no. 737 (1935). The Coney Island dream photograph is also mentioned in "Amazing Electrical Tests Show What Happens When You Think." and Stafford, "Science Takes a Look at Your Brainstorms."



HERE IS A DREAM OF CONEY ISLAND

This photograph taken of the electrical current in a sleeper's arm shows you the picture of a dream. At the left is a record made while the individual was just sleeping and snoring restfully. The right section shows how the waves magnified when the sleeper dreamed he was at the amusement resort Coney Island.

Figure 3.2 Here is a dream of Coney Island, 1936 (illustration)

of a scientific graph.[49] Yet, additionally, with the emphasis on this invention as a type of "dream photography," reports also invoked long-established imaginaries of "thought photography" even while they actively debunked occult and spiritual associations.

Max' "photographic" myographs of dreams exemplified the type of objective, photographic truths EEG graphs were hoped to offer in the future.[50] In the mid-1930s, public demonstrations of physiological nerve-activity graphs were reported as "photographs" or "films" of the active brain. And even when such announcements used inverted commas when they spoke of a "movie of a brain" or the "first sound and motion 'pictures' ever made of the brain in action," these phrases still reinforced the idea that single thoughts could be objectively (photographically) captured by EEG, which strengthened the imaginary of direct access to mental events.[51]

When reporting about EEG (demonstrations), newspaper and magazine reports often hinted at thought reading, personality testing and criminal brain-fingerprinting, yet such hints used a playful, ambivalent rhetoric: thought photography could be speculatively evoked while debunking occult interpretations of science at the same time. A *Popular Science Monthly* article, for example, playfully speaks of a "mind-reading needle," and "thought recorder," yet ultimately remarks that it

[49] Adding to this imagination of potential dream photography, another *Science Service* article by Jane Stafford -"Science Takes a Look at Your Brainstorms."-reported on this by including an illustration of this sleep study: a 'thought cloud' above the head showed the subjects' dream of a merry-go-round, while right next and above the illustration we see an EEG graph.

[50] Even when Louis Max' 'photographs' were in fact based on measurements of action currents in the muscles (not brain cells), reporters intuitively connected his 'photograph of a dream' to the new practice of EEG measurement.

[51] "'Movie' of a Brain Is Exhibited Here: Sound Film Shown at Museum of Natural History Records Reactions to Impulses," *New York Times*, April 18 1937.

was "needless to state" the "electrical mind reader" did not decode actual individual thoughts.[52] The article's mode of address interpellates the reader not only as an awestruck enthusiast of a new technology, but also as a critical reviewer of science, a reader who is capable of separating a legitimate scientific demonstration from the imaginaries of thought reading. Similarly, a week after the front-page *Times* article on the Detroit EEG demonstration, the newspaper's main science editor Waldemar Kaempffert wondered: "But is this really a thought recorder? Do we really see our thoughts on the tape?" Reiterating a sense of marvel at a new technology, he also casts the reader in the role of a critical reviewer who wants to be informed, not misled in thinking that an actual thought recorder exists.[53] Similarly, articles in *Literary Digest* and several other newspapers attempted to set the record straight after the *Times'* spectacular account of the Detroit demonstration: readers should not be deluded and think this a "mind-reading apparatus."[54]

What becomes visible after analyzing popular accounts and remarks by researchers is that demonstrations of EEG and electro-psychophysiology for a wider audience were characterized by a two-sidedness or ambiguity: giving the technology scientific legitimacy while also framing it within a speculative realm (gestures to an elusive future) that evoked attraction and amazement. By describing a scientific demonstration, laboratory environment, or test setup, reporters aimed to relay a sense of the scientific reliability of a direct presentation within their textual account. Eyewitness accounts using direct address allowed readers to vividly engage with the situation through a particular configuration of liveness that propagated this dual effect of scientificity and marvel. At the same time, these articles show another emerging discursive pattern in the portrayal of EEG: a kind of boundary work between legitimate interpretations and occultist beliefs. Science journalists invoked a popular interpretation of EEG (an association with an ambiguous, supernatural, and uncanny realm of thought reading, and parapsychology) to subsequently distance their accounts from this popular position, instead proposing a more nuanced and scientific understanding of the demonstrated phenomena. This debunking was paired with an emphasis on liveliness that aimed to engage readers and spectators with science. This boundary work returns more strongly in the next section, which examines the way scientific EEG demonstrations were reframed in a science exhibition.

[52] The author carefully distinguishes between reading individual thoughts and reading states of mind. Teale, "Amazing Electrical Tests Show What Happens When You Think."
[53] Waldemar Kaempffert, "The Week in Science: The New 'Electrical Thinking'; Activity of the Brain Recorded on a Tape by the Delicate Electroencephalogram," *The New York Times*, April 21 1935.
[54] "Recording Rhythmic 'Brain-Waves'," *The Literary Digest* (1935); Stafford, "Science Takes a Look at Your Brainstorms."

The "white magic" of science: EEG at the 1937 Paris International Exhibition

> Go to the Palais de la Découverte, where an oscillograph will show you, on a photographic film, the shape of the oscillating currents of your own brain. [55]
> —Jean Labadie, *L'Illustration*, 1937.

After its pioneering demonstration in 1934, the public demonstration of EEG found a new highpoint in 1937, which saw the first direct public demonstration for a mass audience at an international science exhibition in the newly founded Palais de la Découverte as part of the Paris International Exhibition.[56] Decades after the event, one witness would recount his experience as follows:

> in a cage, of which you could see the interior, there was a man with numerous electrodes on his head. [...] A scholar explained to us what happened, while at the same time giving orders to the man in the cage – "close your eyes, open your eyes, don't think of anything, re-open your eyes, look at me" – and every time he gave an order, we observed, on a fluorescent tube, a curve that changed position. [...] I thought it was absolutely amazing.[57]

The context of this 1937 International Exhibition enables us to examine the new scientific, modern magic we encountered in the American reports in the previous section in a new sphere. As we saw, this scientific enchantment was most vividly expressed in public demonstrations that offered readers and viewers a particular form of EEG's "liveliness." The demonstration setup at the 1937 Paris exhibition unfolded it as part of a discourse of wonder that structured particular modes of reception. While there are not many accounts of their critical reception, we can gain some sense of how the EEG demonstrations were framed by situating this example within its larger science exhibition layout and examining remarks in exhibition guides and reviews.[58]

[55] Jean Labadié, "Au Congrès Des 'Ondes Courtes'," *L'Illustration*, no. 4930 (1937).
[56] After 1934, other public demonstrations were part of scientific demonstrations, especially in the USA, where EEG-research surged after Edgar Adrian's lecture tour in 1934. See, for example an account of an EEG recording for a larger audience at the Kansas City meeting of the American Medical Association in 1936. J. L. Stone and J. R. Hughes, "I. The Gibbs' Boston Years: Early Developments in Epilepsy Research and Electroencephalography at Harvard," *Clinical EEG and Neuroscience* 21, no. 4 (1990). Millett, "Wiring the Brain: From the Excitable Cortex to the Eeg, 1870-1940," 370.
[57] Charles Penel (who would later become deputy director of the *Palais*) recounting his experience (at age ten) of the 1937 demonstration in a audio-taped interview *1937: The Inauguration of the Palais De La Découverte* (http://videotheque.cnrs.fr/doc=1114?langue=EN2003).
[58] Examining earlier international expositions, Gunning described the typical arc of experience such exhibitions invoke: from a sense of astonishment and bedazzlement effected by a technology's novelty, towards a mode of curiosity and investigation that ultimately results in familiarity with a mechanism or phenomenon, while at the same time retaining

As historian Bernadette Bensaude-Vincent noted, the Palais exhibit should be understood as part of an international landscape in which science communication had a dual aim: scientists promoted science to a wider public and in doing so also aimed to find appreciation and funding for newly developing, specialized branches of science. As Bensaude-Vincent puts it: "paradoxically, the popularization of science played a key role in the professionalization of science" in the 1930s.[59] As part of this promotion of specialization, the Palais exhibition served as an international meeting place for researchers; various scientific disciplines organized their annual scientific meetings around the 1937 event and stimulated participants to visit the exhibits. In the summer of 1937, for example, the EEG exhibit was visited by participants of the International Congress of Psychology (including Hans Berger).[60]

In the 1930s, popularizing (in French: *vulgariser*) science was fervently discussed and scrutinized: scientists pursued active boundary work to distinguish serious popularization efforts from too spectacular or speculative communications. Within this context, the makers of the Palais exhibition emphasized the "pure science" of "scholars, not that of commercial popularizers."[61] At the same time, the makers used popularization innovations, combining museum-display strategies with experiment demonstrations by scientists dressed in white lab coats, rooms with pre-recorded voice-over explanations, and, in some cases, the possibility to touch, push, and use the objects in the show.[62] At the exhibition, as one popular-science magazine claimed, spectators were asked to verify science "with their own eyes" and see "the experimental 'fact', in its most demonstrative form."[63]

Significant elements of the Palais' discourse of wonder are the rhythm and scale of the exhibition experience. While navigating the spaces, visitors would encounter one impressive thing after another – thus evoking a sense of infinitely new supplies of amazement. Walking through the biology rooms, for example, a visitor could see the changing electrical potential of plant cells projected on a screen, a film with bioluminescent fish, and tubes filled with luminescent bacteria

a dimension of astonishment. Gunning, "Re-Newing Old Technologies: Astonishment, Second Nature, and the Uncanny in Technology from the Previous Turn-of-the-Century," 43.

[59] Bensaude-Vincent, "In the Name of Science."

[60] The congress included a special session on EEG chaired by Hans Berger. Henri Piéron and Ignace Meyerson, eds., *Onzième Congrès International De Psychologie: Paris, 25-31 Juillet 1937 : Rapports Et Comptes Rendus* (Nendeln: Kraus Reprint, 1974), 149-57; 231-34; "Psychologisch Congres Te Parijs. Zeshonderd Psychologen Uit Alle Landen Bijeen. Een Hartelijke Samenwerking Van Alle Zijden," *Algemeen Handelsblad*, 4 August 1937; J. B, "Impressions of the Eleventh International Congress of Psychology," *Journal of Consulting Psychology* 2, no. 3 (1938).

[61] Jacqueline Eidelman and Odile Welfele, "Enseignement Supérieur Et Universités; Palais De La Découverte (1900-1978)," (Archives Nationales, 1990), 4.

[62] Ibid. The fact that the didactic aims of such exhibitions might not always have been successful is evident from at least one contemporary commentator, who remarked, in a piece about the "advantages and disadvantages of vulgarization," that "we have seen lectures by great scholars that are just as incomprehensible as most of the exhibitions at the Palais de la Decouverte at the exposition of 1937 (J Noir, "Concours Médical," (1938).)

[63] Jean Labadié, "Que Savons-Nous Des Ondes Électriques Émises Par Le Cerveau?," *Science et Vie* (1937): 218.

shaping the words "*Lumière Végétale*" (herbal light) when fed with oxygen.[64] A review of the exhibition by the renowned cultural critic Siegfried Kracauer typifies this sense of pedagogically-oriented astonishment.[65] To Kracauer, the displays offered an educational spectacle to the crowd, "without succumbing to cheap popularity," a mode he dubbed "white magic":

> One presses a button and obscure models start to function; one walks through mysterious darkness, in which something suddenly crisps and flashes. Nothing more exciting than this white magic. The theory of probability has gained an improbable seduction, and the room with fluorescent phenomena looks like a magician's cabinet. […] Mendelian laws of heredity, atomic theory, X-rays – it is impossible to expound everything in detail.[66]

Kracauer's reference to white magic to describe the atmosphere and approach of the displays characterizes the discourse of wonder summoned by the exhibition, similarly described as "*mystique populaire*" by its principal designer Jean Perrin.[67] Within this discourse, the visitor is cast not as someone interested in comprehensively understanding the displays, but as a spectator suspended in a continuing state of inquisitive attraction. This mystical or white-magical aspect could be deemed as appropriate popularization, especially because the overarching emphasis of the exhibition's paratexts was on serious, specialized science presented by authoritative scientists.

This white-magic discourse also underpinned the exhibition's EEG-demonstration setup, which was part of the biology exhibition's section on bio-electrical waves organized by the French neurophysiologist Alfred Fessard.[68] Combining expertise in neurophysiology and psycho-physiology (he had trained with French physiologists and psychologists, as well as with Matthews and Adrian in Cambridge), Fessard had co-published his first paper on EEG in 1935, examining the relation between EEG and mental activity by studying changes related to varying visual and

[64] R. Bonnardel, *La Biologie: Exposition Internationale De Paris 1937* (Paris: Palais de la Découverte, 1937).
[65] Siegfried Kracauer, "Kosmos Der Wissenschaften-Konglomerat Der Kunste," *Das Werk; Schweizer Monatschrift für Architektur, Freie Kunst, Angewandte Kunst. Offizielles Organ des Bundes Schweizer Architekten BSA und des Schweizerischen Werkbundes SWB* 25, no. 1 (1938). Similar to contemporaries Walter Benjamin and Siegfried Giedion, Kracauer was generally enticed by the promise of the medium of the exhibition. "Ein Neuer Typus Von Ausstellungen," *Das Werk; Schweizer Monatschrift für Architektur, Freie Kunst, Angewandte Kunst. Offizielles Organ des Bundes Schweizer Architekten BSA und des Schweizerischen Werkbundes SWB* 25, no. 1 (1938).
[66] "Kosmos Der Wissenschaften-Konglomerat Der Kunste," 21-22.
[67] Jean Perin, Préambule du Projet de Palais de la Découverte, Décembre 1935, cited in Eidelman and Welfele, "Enseignement Supérieur Et Universités; Palais De La Découverte (1900-1978)," 5.
[68] On Fessard's work, see Jean-Gaël Barbara, "The Fessard's School of Neurophysiology after the Second World War in France: Globalistion and Diversity in Neurophysiological Research (1938-1955)," *Archives Italiennes de Biologie* 149 (2011). The EEG exhibit had already been announced as coming to the international exhibition. See N.A., "Wat Denkt Gij?," *Limburger Koerier*, Maart 1937.

auditory stimuli.[69] The paper evinces the uncertain and exploratory approach to EEG research, but also the enthusiastic tone of the researchers, who described the revelatory experience of seeing the brain at work. It was "banal but striking", they explained, to abruptly see a motionless spot on the oscillograph change when a subject closed their eyes on the operator's command, now "suddenly animated into a regular vibration that can be evaluated by the eye."[70]

In 1937, it was this striking but simple visuality of EEG research that was put on public display at the Palais when Fessard placed the EEG-testing setup in one of the exhibition rooms, where it would remain on view for at least a decade.[71] A photograph of the room printed in the popular-science magazine *Science et Vie* gives an overview of the layout (which included the "magic device" of the vacuum tube at its core, the magazine mentioned).[72] [Figure 3.3] Importantly, during EEG demonstrations, visitors would be able to see the subject in a booth as well as the simultaneously measured EEG oscillations on a projection screen.

In the official guide that accompanied the biology exhibit, Fessard framed EEG with future-oriented enthusiasm. Even though "we are still in a period of clumsy fumbling" when it comes to understanding brainwaves, EEG offered a valuable "direct sign" that would definitely lead to future practical applications.[73] Again, the exhibition also shows moments of boundary work when white magic was separated from previous para-scientific imaginaries. Fessard took pains to dissociate his display of the body's electricity from "fantastic or premature interpretations that circulate, and too often reverberated in the press."[74] Perhaps to distance himself from the popular bio-radio-electrical therapeutics (which had been much critiqued in scientific circles and newspapers) of George Lakhovsky conducted in the 1920s at Paris' Salpetrière hospital, Fessard

[69] G. Durup and A. Fessard, "I. L'électrencéphalogramme De L'homme. Observations Psycho-Physiologiques Relatives À L'action Des Stimuli Visuels Et Auditifs," *L'année psychologique* 36, no. 1 (1935). Most of the examinations on which this 32-paged article was based were conducted on one subject, Gustave Durup himself, because of his consistent alpha activity and experience with psychological testing. Fessard's French intellectual predecessors and teachers were physiologists Louis Lapicque and Paul Portier, and psychologist Henri Pieron. Previous research in physiology and new research with EEG reciprocally corroborated one another. Cornelius Borck has aptly described this interfacing as a "trading zone": EEG gained significance in relation to existing research questions, while those research hypotheses could gather new credibility through the application of EEG. Borck, *Brainwaves*, 202.

[70] Though the underlying physiology was uncertain, Fessard and Durup wrote that "the best way to know the instrument [...] is to use it," as psychological data will indirectly help to "understand the physiological mechanism itself." (Durup and Fessard, "I. L'électrencéphalogramme De L'homme. Observations Psycho-Physiologiques Relatives À L'action Des Stimuli Visuels Et Auditifs," 3.) ibid., 4.

[71] Denise Albe-Fessard recounts a visit to the set-up in 1943. Denise Albe-Fessard, "Denise Albe-Fessard," in *The History of Neuroscience in Autobiography. Volume 1*, ed. Larry R. Squire (Washington: Society of Neuroscience, 1996), 13.

[72] Labadié, "Que Savons-Nous Des Ondes Électriques Émises Par Le Cerveau?."

[73] A. Fessard, "Les Ondes Bioélectriques. De La Décharge Du Poisson-Torpille Aux Oscillations Electriques Du Cerveau Humain," in *La Biologie: Exposition Internationale De Paris 1937*, ed. R. Bonnardel (Paris: Palais de la Découverte, 1937), 68.

[74] Ibid., 58.

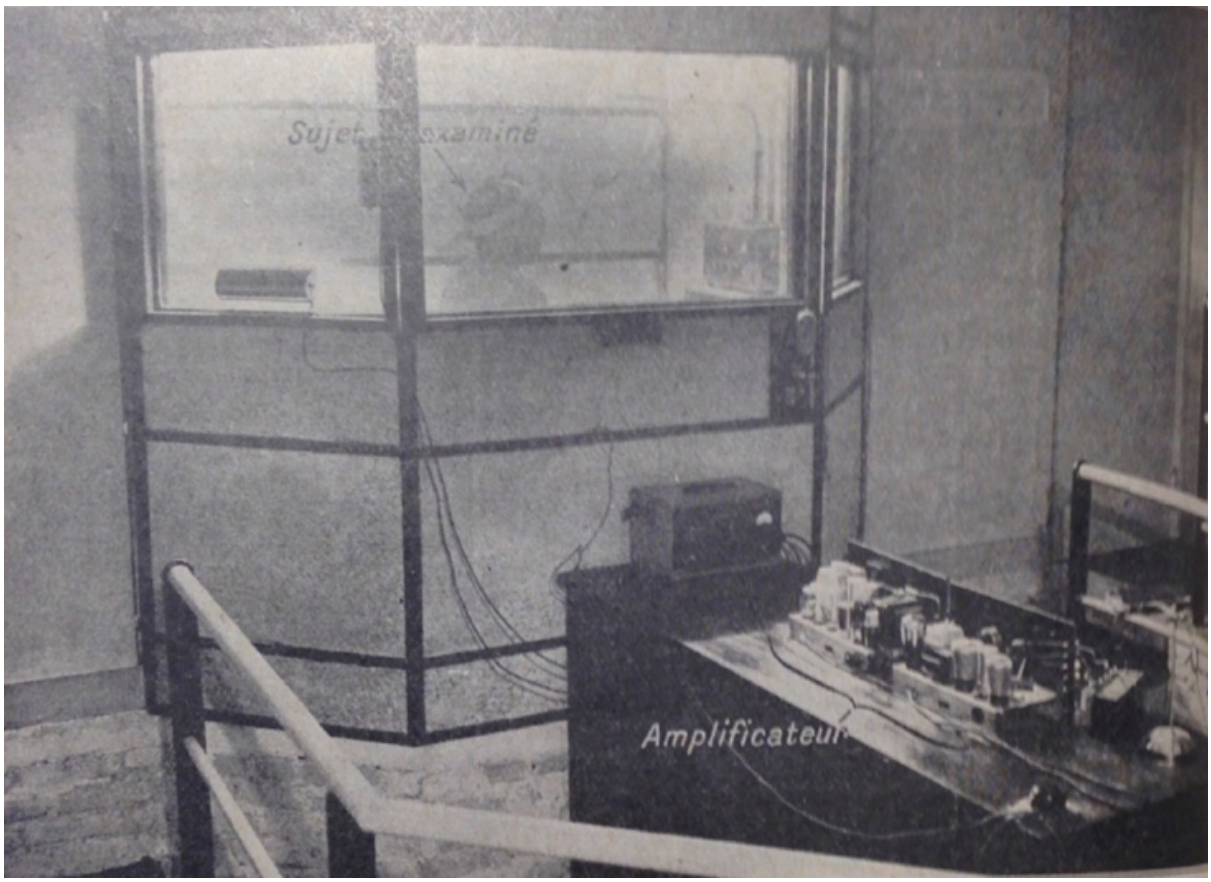


Figure 3.3 Electroencephalography booth in the exhibition La Biologie: Exposition Internationale De Paris, at the Palais de la Découverte as part of the Paris International Exposition, 1937 (photograph)

emphasized that the body did not emit or send activity like a radio, but that fluctuating electrical potentials were fundamentally part of all living processes at the cellular level, including nerve cells.[75] The bioelectrical wave, he said, had nothing to do with speculative phenomena such as animal magnetism or character dowsing. By aligning the discovery of electroencephalography with a much longer and established history of bioelectricity, Fessard aimed to present brain activity as a regular and intelligible phenomenon, now visible due to new technological machines that could amplify them.

Yet while Fessard tried to typify all physiological waves, including brainwaves, as "normal" (*banal*) phenomena, the electroencephalography exhibit also framed the technology in relation to possibly spectacular future applications. In the catalogue, Fessard adopted a promissory tone when he asked, "can normal people be classified in distinct nervous types according to the shape of their

[75] On Lakhovsky, see Borck, *Brainwaves*, 104-11; Alfred- W. Gaspart, "L'oscillation Cellulaire Possède-T-Elle Une Vertu Thérapeutique?," *L'Homme Libre*, November 04 1931..

electro-encephalogram?", answering that this was "impossible to foresee."[76] His speculation framed EEG as a prospective tool for nervous profiling, a psycho-diagnostic instrument.[77] This connection of EEG to the realm of psychotechnics and diagnostics becomes more evident if we view Fessard's exhibit within the larger Palais exhibition, where it was positioned next to the "Human Biometrics" section, an interactive exhibit that allowed visitors to compare their physiological and mental capacities (intelligence, memory, sensory acuity, physical strength) to those of other visitors and to statistical averages on display.[78] This amenability between EEG and psycho-metrics was made explicit in *Science et Vie*, which reported on the biometrics section and included the adjacent section on EEG ("a quasi miraculous" method) in its description of a broader practice of psycho-technology. Hence, the 1937 exhibition's layout and paratexts placed EEG in line with an established practice of psycho-diagnosis and mental profiling.

Whether EEG was also tested as a potential biotypological research method in the late 1930s and early 1940s remains a question for further historical research (quite possibly, though it was too premature to be practically employed in the 1930s). However, in the introduction to this thesis I mentioned Foucault's work with EEG as part of vocational and personality testing in the 1950s, which shows how the technology had by that time become part of a regular set of test instruments. Within Fessard's Parisian research environment, psycho-physiological research (which had now started to include EEG) was clearly conducted in close association with research avenues in *biotypologie* and psychotechnics (vocational testing, intelligence testing).[79] EEG research was also marked by this wider research landscape and characterized by an interest in creating typologies. Within this paradigm, EEG testing was predominantly understood as potentially recording individual characteristics. Accordingly, historians Lorraine Daston and Peter Galison have described EEG and other biotypological projects in the 1930s as pervaded by an undercurrent of "physiognomic sight," a new confidence in trained researchers' technologically-assisted capacity to recognize family resemblances in physiological data, which thus served categorizations in populations of subjects.[80]

[76] Fessard, "Les Ondes Bioélectriques. De La Décharge Du Poisson-Torpille Aux Oscillations Electriques Du Cerveau Humain," 58.
[77] Durup and Fessard, "I. L'électrencéphalogramme De L'homme. Observations Psycho-Physiologiques Relatives À L'action Des Stimuli Visuels Et Auditifs."
[78] Charles Brachet, "La Découverte Scientifique: Création Continue. Le 'Banc D'essais' De La Machine Humaine Au Palais De La Découverte," *Science et Vie* 241 (1937).
[79] Fessard's mentor Henri Pieron had been a dominant researcher in intelligence testing and a new 'docimology' testing procedure in France. He was chair of the department of physiology of sensations at College de France and vice-president of Laugier's Société de Biotypologie (1932) and Laboratoire de Biometrie (1938) William H. Schneider, "After Binet: French Intelligence Testing, 1900–1950," *Journal of the History of the Behavioral Sciences* 28, no. 2 (1992); Luigi Traetta, "Docimology Enters into Psychology: Dagmar Weinberg's Work in French Applied Psychology Laboratories," *International Review of Social Sciences and Humanities* 4, no. 2 (2013).
[80] Lorraine J. Daston and Peter Louis Galison, *Objectivity* (Cambridge, Mass.: MIT Press, 2007), 337-8.

Yet, while it must thus be viewed as part of a larger biopolitical research project, drawing a direct connection between EEG and the racial and eugenic ideas of the 1930s ignores the historical complexity of this field. Biotypological research was linked to a wider preoccupation with what Daston and Galison have termed the "totalistic recognition" that was foundational to Gestalt psychology and racial theories in the 1930s and 1940s. In the French context, for example, biotypologies were also part of psychotechnical research approaches by socialist and communist psychologists who aimed to provide vocational guidance for underprivileged students.[81]

Ultimately, what is important to remark in the context of the 1937 exhibition is the fact that the political potential of biometrics (with EEG in its vicinity) may not have been clearly visible to exhibition visitors. As Sybille Nikolow has argued in the context of German psychotechnical exhibits, "the attractiveness of scientific diagnostic practices for the politically motivated social management of modern society is probably in the (at first sight) apolitical-looking character of these practices."[82] The biometrics exhibit emphasized visitors' interactive engagement and the fun of gaining new insight in oneself. As *Science et Vie* mentioned, everyone wanted to know about the "metric factors concerning their modest person."[83] In tandem, the adjacent EEG exhibit followed a white-magic strategy, offering an opportunity to marvel at the technological ingenuity of the setup as part of a future-oriented scientific project.

This context of wonder also prompted Fessard to imagine ingenious new technological mediations of brainwaves. While nerve research had already been vividly mediated with the help of neon lights and audio speakers (as he noted in the exhibition guide), he now proposed an even more spectacular EEG setup: in the future, the electric EEG oscillations could operate a relay triggering "any grandiose event," such as "the departure of an electric train, or opening the doors of the exhibition."[84] Fessard's vision of merging EEG activity and electro-technology was the

[81] Paul-André Rosental, "Eugenics and Social Security in France before and after the Vichy Regime," *Journal of Modern European History* 10, no. 4 (2012).

[82] "'Erkenne Und Prüfe Dich Selbst!' in Einer Ausstellung 1938 in Berlin. Körperleistungsmessungen Als Objektbezogene Vermittlungspraxis Und Biopolitische Kontrollmaßnahme," in *Erkenne Dich Selbst!: Strategien Der Sichtbarmachung Des Körpers Im 20. Jahrhundert*, ed. Sybilla Nikolow (Köln: Böhlau, 2015), 230. As such, exhibitions of biometrics served what Michael Tymkiw has dubbed "agitational propaganda": a more indirect type of message that stressed individual health and (implicitly) invoked a connection to the nation's health, thus promoting understandings that were congenial to a biopolitical agenda of recording populations. Michael Tymkiw, "Engaged Spectatorship. On the Relationship between Non-Museum Exhibitions and Museums in National Socialist Germany," in *Museen Im Nationalsozialismus: Akteure – Orte – Politik*, ed. Tanja Baensch, Kristina Kratz-Kessemeier, and Dorothee Wimmer (Köln Weimar: Böhlau Verlag, 2016), 173.

[83] *Science et Vie* described the particular attraction of this stand. Visitors could obtain these profiles relatively simple, by themselves and everyone was curious about the "metric factors concerning his modest person." Brachet, "La Découverte Scientifique: Création Continue. Le 'Banc D'essais' De La Machine Humaine Au Palais De La Découverte," 5-6.

[84] Fessard, "Les Ondes Bioélectriques. De La Décharge Du Poisson-Torpille Aux Oscillations Electriques Du Cerveau Humain," 68.

epitome of EEG's white magic – an evocation of amazement without comprehensive understanding spurred by the science exhibition's discourse of wonder. It shows how exhibiting spectacular technological setups did not provide conclusive answers about the meaning of brainwaves (neither to scientists, nor to laymen), but allowed for imagining new electro-technological assemblages – a future world of new brainmedia, a world in which brains could open doors.

The EEG's imagined future remained apolitical in this exhibition context, even in its proximity to a project of biotypology. Brainwaves were presented as a wonderful, newly visible, but ultimately "normal" phenomenon in the technological age. In contrast, the last part of this chapter will show that EEG also spurred adverse reactions and interpretations. EEG's eerie qualities as an uncanny medium visualizing the mental realm made it possible to not only perform boundary work in the demarcation of science from pseudoscience, but also to critique the aims and effects of scientific and technological developments.

Dark brain media in Hollywood

Throughout the 1940s, EEG remained a phenomenon in search of its significance. In a 1947 state of the art of psycho-physiology and EEG, one reviewer noted that while EEG had been useful in detecting cerebral tumors or forms of epilepsy, it "has contributed thus far surprisingly little to psychology."[85] This scientific uncertainty meant that scientists and science communicators had to keep navigating ambiguities when articulating brainwave research. In the previous two sections, I described EEG's ambiguous forms of liveliness (particularly connected to EEG demonstrations) as they were negotiated in newspapers and science exhibitions. These both invoked as well as debunked older, supernatural views of brainwave technologies, an oscillation that went hand in hand with the emergent portrayal of EEG as a spectacular yet scientific phenomenon expressed through the aesthetics and discourse of white magic.

Around 1940, this debunking of supernatural and uncanny interpretations of EEG had become a rhetorical commonplace for scientists and science communicators. In the first *Atlas of Encephalography* in 1941, the authors acknowledged that EEG "may at first seem strange" and even "fantastic," but that viewers should not be too puzzled, as the phenomenon of brainwaves "should become quickly familiar."[86] In a section on "the electroencephalographer's place in nature," they

[85] Chester W. Darrow, "Psychological and Psychophysiological Significance of the Electroencephalogram," *Psychological Review* 54, no. 3 (1947): 157. "Evidently we either have not yet learned how to interpret the EEG psychologically or else the EEG is not a record of the integrative activities of the cortex."
[86] Frederic Gibbs and Erna Gibbs, *Atlas of Electroencephalography* (Cambridge, Mass.: Cummings, 1941), 18.

explained EEG graphs as providing "broad-focus eyes," merely intensifying or extending our natural ability to see.[87] The 1941 *Atlas* was the culmination of six years of searching (since 1934) for characteristic EEG records that correlated with particular mental tasks and personality profiles.[88] By the late 1930s, the mountain of recorded EEG data had started to be stored on punch cards and could be evaluated by means of a new frequency analyzer that could read and compare records faster.[89] The *Atlas'* authors emphasized that this new technological assistance now allowed trained professionals to objectively analyze an EEG with an experienced "seeing eye," as if "recognizing a person by his features."[90] While EEG assessment had previously been "more art than science" according to the inventors of the EEG-frequency analyzer, the *Atlas'* authors now claimed that "the problem of visual analysis of electroencephalograms resolves itself into a fairly simple task of recognition – much like learning to read a new language with an unfamiliar alphabet and different kinds of script."[91]

Throughout the *Atlas*, the tone was one of promissory enthusiasm about EEG's ultimately revelatory photography-like powers. Yet, this future-oriented tone also unavoidably made it clear that EEG did not provide all the answers yet. Because one still needed "a brain to analyze a brain," the "ultimate solutions to the problems of electroencephalography" were still ahead.[92] Hence, within this atmosphere of EEG's imminent anticipated value, the act of debunking the fantastic and strange allowed scientists to garner some necessary scientific legitimacy in an otherwise uncertain situation. The dual invocation and denunciation of EEG's uncanny in 1941 must thus be understood as both a commonplace assertion of scientific authority as well as suggesting a necessary sensibility on the part of a science audience, a rhetorical move that diverted attention from the uncertainties at the heart of EEG research.

While the uncanny has so far appeared as a rhetorical trope to demarcate genuine science (and serious popularization) from laymen's naïve and backward interpretations, the uncanny could also be a resource to articulate a different mode of reception vis-à-vis science. The 1941 Hollywood film *The Devil Commands* is evidence of this alternative portrayal of brainwave-measurement

[87] Ibid.
[88] Borck notes the US dominance in the rapid expansion of the correlative analysis of EEG typologies, noting the influence of the competitive situation that forced research teams to "specialize on new fields of application or to secure an advantage by new data-processing techniques with which they could find and maintain an audience on the flourishing market." Borck, *Brainwaves*, 197.
[89] Albert M. Grass and Frederic A. Gibbs, "A Fourier Transform of the Electroencephalogram," *Journal of Neurophysiology* 1, no. 6 (1938).
[90] "Seeing eye" in Gibbs and Gibbs, *Atlas of Electroencephalography*, IV. "Recognition of features" in W. G. Lennox, E. L. Gibbs, and F. A. Gibbs, "Inheritance of Cerebral Dysrhythmia and Epilepsy," *Archives of Neurology & Psychiatry* 44, no. 6 (1940): 1158. On learning to become an expert EEG-record reader, see Lee Edward Travis and Abraham Gottlober, "Do Brain Waves Have Individuality?," *Science* 84, no. 2189 (1936).
[91] Gibbs and Gibbs, *Atlas of Electroencephalography*, 112.
[92] Ibid., 68.,

technologies. I argue that this particular popular portrayal of brainwave science subverted the symbolic power of the technology's uncanny character, employing it instead to articulate a position of distrust about both the morality and veracity of brain research. While we may conventionally think of popular media, especially Hollywood films, as exaggerated, science-fictional, and future-oriented portrayals of science and technology, the example of *The Devil Commands* shows the simultaneous potential for a skeptical position.

Seven years after the first public demonstration of brainwaves in Cambridge, *The Devil Commands* was the first mainstream Hollywood production to portray the conspicuous science of brainwaves. Following the conventions of the haunted-house genre, the atmosphere of the film is set by gloomy weather, night skies lit by lightning, dark rainy streets, and power cuts. Boris Karloff stars as a respected scientist gone haywire, convinced that there is life after death and that a newly invented brainwave reader will allow him to communicate with his recently deceased wife. The film framed this novel scientific invention within a humorously hyperbolic narrative of supernatural powers and eeriness. Because of their shared liminal capacity to traverse established ontological realms – between the visible and usually invisible, between the materiality of the body and the immateriality of thought – this association of brainwave machines and scientists with the supernatural and parascientific resembled the discourse on x-rays decades earlier.

The Devil Commands followed a number of popular science-fiction stories that gave imaginative substance to the futuristic possibility of capturing brainwaves and did so with characteristic dramatic exaggeration, employing the uncanny to portray (brain) science with a mocking irony.[93] This ironic stance vis-à-vis thought visualization followed a current present in fiction since the late nineteenth century which exhibited growing skepticism about the scientific discoveries of neurologists and thought photographers.[94] Literary scholar Sabine Haupt has characterized the 1920s and 1930s as the height of this skepticism, when the literary motif of thought visualization became increasingly perfused with a critique of capitalist and totalitarian regimes intruding on private life.[95] Oftentimes, plot turns conveyed a mistrust of the veracity of the newly visible entities – a clear suspicion of new mediating technologies – and alluded to the

[93] Some literary examples are Willard Rich' *Brain-Waves and Death* (New York: C. Scribner's Sons, 1940). and William Sloane's *The Edge of Running Water* (London: Hachette UK, 2013 [1939]). Not long after *The Devil Commands* Curt Siodmak's *Donovan's Brain* (New York: Alfred A. Knopf, 1943). was adapted for cinema multiple times: *The Lady and the Monster (1944), Donovan's Brain (1953), and The Brain (1962).* Historian Melissa Littlefield analyzes various thought-translator stories in American science-fiction magazines of the 1930s and notes the ubiquity of fictional machines (neuro-cameras, mental microscopes) that could immediately translate thoughts into sounds, words, or images. Littlefield, *The Lying Brain*, 76.

[94] Haupt, "'Traumkino.' Die Visualisierung Von Gedanken: Zur Intermedialität Von Neurologie, Optischen Medien Und Literatur."

[95] Ibid., 115. Haupt points to various critiques of the corruptibility of capitalist scientific institutions, of a science that is only interested in moneymaking inventions and profitable patents.

unreliability and hubris of scientists and their scientific practices. Hence, the imaginaries of thought reading and brainwave communication these narratives proposed were heterogeneous and ambiguous; they could both be critical of, and at the same time contribute to, a growing attention to "photographic" and "objective" measurements of mental phenomena and to a materialist understanding of the mind.

In a key scene at the beginning of *The Devil Commands*, the professor reveals his new brainwave reader to a group of colleagues during a scientific demonstration. A fantastic transmutation of existing technological equipment, the brainwave-reading apparatus is said to produce a fingerprint-like "portrait of the mind." To operate it, a subject must be encased in an iron helmet connected to a complicated machine that operates a giant mechanical arm producing a zigzagging graph. The professor invites one visitor to become a test subject, while the others see a direct inscription of his mental activity on a large screen in the back of the room. While, he states, some may think this impossible ("like we used to think about radio"), one day this device will record individual thoughts and "unlock the secrets of the human mind." Shot over the shoulders of the gathered scientists, this scene transposes the viewer in the position of a similarly incredulous and amazed spectator of science [Figure 3.4]. Both the professor figure as well as the scientific method on display are presented ambiguously, raising the question: has the professor turned mad or evil, overstepping the ethical boundaries of science, or is the brainwave reading perhaps a hallucination on the part of the scientist, or us, viewers ourselves?

In *The Devil Commands*, the professor's quest to contact his deceased wife turns him into an irrational and reckless experimenter who accidentally fries his subjects' brains. Through his unbelievable claims and aspirations, the film not only foregrounds the uncanniness of the technology, but also makes the viewer wonder whether the scientist, and the scientific system itself, has become delusional – an allusion to the potential hubris of modern science and technology.[96] As such, the film follows the typical "overreacher" plot of horror tales – the hubris of scientists going too far – with a type of uncanniness that Tom Gunning calls the "optical uncanny," i.e. an uncanny sensation on the part of the viewer triggered by a doubt whether what new technologies make visible is real or imagined.[97] A variety of other stories and films portrayed brain science within this realm of the optical uncanny. They show brain scientists as searching for new objective

[96] Early on in *The Devil Commands*, viewers receive the first hint that the scientist himself might be plagued by his imagination. The voice of his wife that Blair appears to hear clearly is only barely audible to the viewer, and when Blair's daughter enters his laboratory he first mistakes her for his deceased wife.

[97] Tom Gunning, "Uncanny Reflections, Modern Illusions: Sighting the Modern Optical Uncanny," in *Uncanny Modernity; Cultural Theories, Modern Anxieties*, ed. John Jervis (London: Palgrave Macmillan, 2008). Gunning's optical uncanny connects to the "fantastic hesitation" (between psychological and supernatural explanations of extraordinary things) common to the genre of the fantastic. Garrett Stewart, *Framed Time: Toward a Postfilmic Cinema* (Chicago:

Figure 3.4 Edward Dmytryk, The Devil Commands, 1941 (film still)

knowledge but making our reality all the more perplexing and disturbing in the process.[98] As new or imagined technologies offered strange new modes of vision, the uncanny dimension of these stories expressed the "ambiguities of mediated vision" not only to evoke a sense of awe, but also to question both the epistemological and moral trustworthiness of these new technologies.[99]

University of Chicago Press, 2008), 83. On the overreacher plot and portrayals of scientific hubris, see: Noel Carroll, *The Philosophy of Horror: Or, Paradoxes of the Heart* (London: Taylor & Francis, 1990), 118.

[98] Brain science and brain reading featured extensively in fictional tales about supernatural phenomena, haunted houses, spiritualist séances, and hypnosis such as Edward Lytton's "The Haunted and the Haunters, or, the House and the Brain," *Blackwell's Magazine*, August 1859. Even when such stories culminated in a debunking of the phenomenon, the sense of a supernatural link had already been established. A familiar strategy in some fictional accounts of brain science is to combine and oscillate between tropes of revelatory science and the hallucinations of lone mad scientists, such as for example in nineteenth-century tales about the invention of thought-visualizing machines in Edward Mitchell's "The Soul Spectroscope," *The Sun*, December 19 1875. and Edward Bellamy's *Doctor Heidenhoff's Process (London: W. Reeves, 1890).* In turn, however, the brain scientists in these narratives are revealed to be unreliable narrators, and the brain-revealing device itself may ultimately just be a figment of the scientist's imagination. Lysen, "The Brain Observatory and the Imaginary Media of Memory Research."

[99] Gunning, "Uncanny Reflections, Modern Illusions," 79.

Media philosopher Eugene Thacker has coined the term "dark media" to refer to these uncanny mediating technologies.[100] Dark media are the procedures, machines, and circuits that "work too well," moving beyond the capacity of the human senses to mediate "between different ontological domains – the natural and the supernatural, the normal and the paranormal, life and the afterlife."[101] Fictional tales that portray new technologies as dark media particularly reflect on the status of mediation, flagging the doubtful evidentiary status of visual technologies. As such, the optical uncanny of dark media conjures a double movement: on the one hand positing a suspicious and critical viewer capable of debunking fraudulent, hallucinatory science, on the other hand maintaining the association between optical media and the realm of the supernatural.[102]

If we interpret *The Devil Commands* as playing with the optical uncanny and framing brainwave readers as dark media, the film thus also contributes to a new mode of reception, a specific positioning of the layman spectator of science. Throughout the film's comical back and forth between scientific rigor and supernatural realms, spectators of science are portrayed as navigating between amazement and critique. In one scene, the brain scientist attends a spiritualist séance and exposes it as simple optical trickery ("I hate to disillusion you, but...").[103] While the séance is exposed as false, the medium's electrical nervous powers are presented as real. After wiring the medium with a brain-writing machine, the scientist assures her it "is science, nothing occult about it." An occult performance is thus dismissed to lend more credibility to a scientific demonstration, while at the same time re-associating brainwave measurement with spirit mediums and supernatural powers. Spectators of science are here placed in an oscillating position between recognizing the accomplishments of a wonderful science and evaluating the boundary-transgressing hubris of hallucinatory scientists. Portraying EEG as dark media and framing its optical uncanny qualities, *The Devil Commands* reinforces an oscillatory stance that we saw glimpses of in newspaper accounts but that obtains a particularly critical dimension within the context of this fictional tale.

[100] Eugene Thacker, "Dark Media," in *Excommunication: Three Inquiries in Media and Mediation*, ed. Alexander R. Galloway, Eugene Thacker, and Wark McKenzie (Chicago: University of Chicago Press, 2013).
[101] Ibid., 102.
[102] This is what Gunning calls the "untimely palimpsest," "in which older models remain legible beneath the inscription of new concepts, especially on the level of popular explanation or artistic metaphor, as if supernatural explanations still haunted the optically obtained virtual image." Tom Gunning, "To Scan a Ghost: The Ontology of Mediated Vision," *Grey Room* 26 (2007): 109.
[103] Here, *The Devil Commands* follows a familiar motif in haunted-house films: exposing the spiritualist to disprove paranormal phenomena. As Simone Natale has argued, haunted-house comedies between the 1930s and 1960s often staged this "rationalizing discourse," equating spectral appearances with trickery and the general deceptive qualities of the mind and senses, yet often remaining ambiguous about the ultimate status of ghosts and the supernatural. Simone Natale, "Specters of the Mind: Ghosts, Illusion, and Exposure in Paul Leni's the Cat and the Canary," in *Cinematic Ghosts: Haunting and Spectrality from Silent Cinema to the Digital Era*, ed. Murray Leeder (London: Bloomsbury Publishing, 2015).

Conclusions

Between 1934 and 1941, scientists, science reporters and film makers needed to navigate an uncertain terrain in communicating about the elusive and developing technology of EEG. In my first example I show how scientists and science news reporters portrayed nerve research in relation to a long-established imaginary of brainwave media and thought readers that was closely tied to associations with the supernatural and often framed within the vocabulary of the uncanny, with a particular focus on technology's animating and liminal powers to render the invisible visible. Often, scientists and science reporters invoked the uncanny as a newly pacified delight, a conquered remnant of bygone era of supernatural magic that was proof of a more modern, technological, and scientific sensibility. To mention and then denounce the uncanny allowed them to distance themselves from an older, magical understanding of science – a mode to which a serious reader or viewer of science should no longer adhere. Calling upon the supernatural thus invoked a multilayered mode of reception: it summoned a serious contemporary witness of science, one that could appreciate the wonder of EEG as an ingenious technology, a modern type of magic that was stripped of its false supernatural powers. In my second example, the 1937 Paris International Exhibition, a live EEG exhibit was part of a discourse of (what Siegfried Kracauer called) white magic, presenting it as incredibly yet scientifically real. Within this mode of reception, the contours of an implicit biopolitics of EEG were only vaguely visible, eclipsed by EEG's white magic as part of a mysterious bioelectric universe in which electric brain potentials were imagined as triggering electric trains or opening exhibition doors. Finally, the portrayal of brainwave reading in the 1941 movie *The Devil Commands* presented a particular ironic uncanny, marking brainwave readers as strange and uncertain visualization technologies and opening the possibility to question this scientific invention, conjuring a potentially skeptical spectator of science.

My analysis shows that the emergence of professionalizing platforms and practices for science popularization led to a new emphasis on vivid demonstrations of the new EEG technology in action. These live demonstrations with nervous subjects, scribbling ink-writers and/or moving lights on oscilloscope screens were intended to offer a direct engagement with a new scientific phenomenon. In the examples I examine, performing knowledge about the brain at work in newspapers, an exhibition and a Hollywood film, invoked oscillating forms of liveness, interpretations that wavered between the "liveliness" of scientific demonstrations (life-like, direct, and vivid) and the strange "aliveness" of this new scientific phenomenon. Mapping these ambiguities shows how supernatural interpretations of brainwaves were often rhetorically invoked so as to be dismissed, thus establishing a modern, yet magical attitude towards this new science. These equivocal narratives of *mystique populaire*, "white magic," and "dark media" reverberated

across different spheres of performing science. My analysis ultimately suggests that drawing a rigid divide between the performative practices of "serious" scientists and "popular" science communicators is inadequate. Instead, I highlight their shared tropes and rhetoric.