Brainmedia

One hundred years of performing live brains, 1920–2020

Lysen, F.C.

Publication date
2020
Document Version
Other version
License
Other

1. The Birth of the Live Brain, 1820–1920

My story of the "live brain" begins with an image of a woman, writing. [Figure 1.1][1] She has the bobbed haircut and striped blouse fashionable for female white-collar workers in American cities around 1920 – and though we might expect her to use a typewriter, she is using a quill pen and ink. Pasted over her head is a drawing of the cerebral organ in its simplified outlines. Hand-drawn arrows label four little blots inside the brain as the "centers" for hearing, speech, sight, and motion. From these, dotted lines run to the corresponding senses: the woman's ear, mouth, eyes, and writing hand. The view inside her head – not dissected, but simply made transparent through superimposition – gestures towards the idea of seeing a living brain at work, perceiving, as it were, active cerebral substances mirror this writer's activities. Even more than an image of a woman at work, this is an image of a brain at work.

It is no coincidence that this is a woman's brain. Lisa Cartwright has emphasized the female body's frequent appearances in discourses of, and advertisements for, modern visualization technologies (such as x-rays) which frame them as opaque entities: ideal subjects to be rendered transparent by a superior, technological-scientific, male gaze, an act that was implicitly or even explicitly equated with sexual looking.[2] From the dawn of the brain and mind sciences until this day, women feature as exemplary subjects in photographs of laboratory work as well as in advertising for neuro-technologies.[3]

I zoom in on this specific image, inscribed with longstanding traditions of gendered scientific depiction, from around 1920 to signal a historical convergence. The image allows us to discuss both the nervous *past* extending into the 1920s and the 1920s' *present* extending into the future. I will show how this image evinces both the persistence of nineteenth-century conceptions in the mind and brain sciences and a particular promise towards a future understanding. The early decades of the twentieth century were a time of ambiguity about how the brain and human nervous system could be thought. In broad strokes, and with the help of the writings of Michel Foucault, this chapter's historical account sketches the way conceptions of media and mediation were articulated in relation to the human nervous system and the modern human at this time.

[1] Complete source information of figures is provided towards the end of this dissertation.
[2] Lisa Cartwright, *Screening the Body: Tracing Medicine's Visual Culture* (Minneapolis: University of Minnesota Press, 1995).
[3] Paula Gardner and Britt Wray, "From Lab to Living Room: Transhumanist Imaginaries of Consumer Brain Wave Monitors," *ADA. Journal of gender, new media and technology*, no. 3 (2013), https://adanewmedia.org/2013/11/issue3-gardnerwray/.

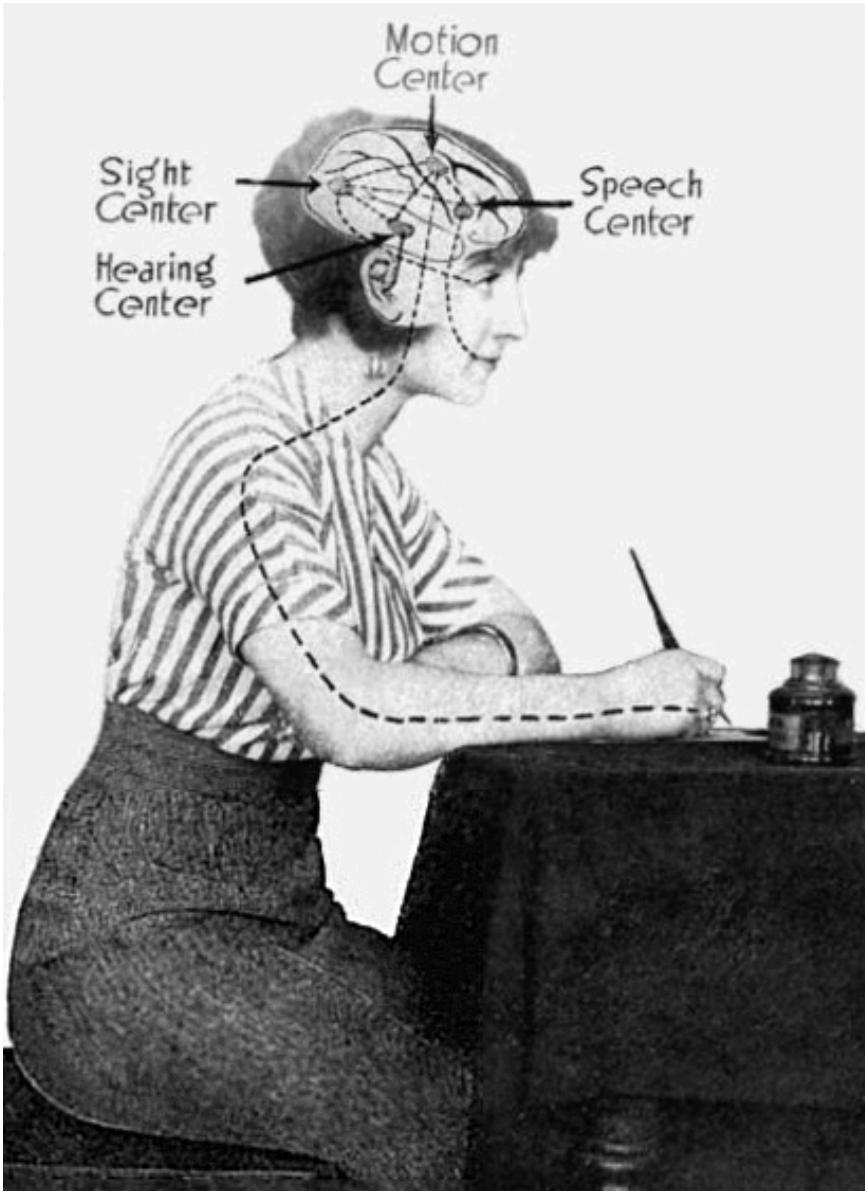

Figure 1.1 Diagram showing the four chief association centers of the human brain, c. 1919 (illustration)

I argue it is in this historical context that a new way of thinking "the brain at work" emerges – the live brain – and my case studies of brainmedia in Chapters 2 through 6 should be read against the backdrop of this argument.

Beginning with this "minor" image – uncanonical, forgotten, idiosyncratic – this chapter proceeds in four steps. First, I describe how the image builds on longstanding ideas of the human sensorium, still present in 1920, that used new media-technologies to articulate it as intimately part of the modern environment. This allows me to use the image as an example of the new structures and forms through which scientific knowledge circulated. Second, I turn to the image's blots and dotted lines to analyze what was left of nineteenth-century physiology and anatomy. Particularly important in this respect is to understand the changing ways in which the relation between brains and living bodies was actively configured. To do so, I turn to Foucault's reflections on the

"anatomo-clinical" and "neurological" gaze, zooming in on his narrative of the "disappearance of the great neurological hope": the nineteenth century's disappointment about the failure to systematically correlate brain lesions and (abnormal) human behaviors. Third, drawing on Foucault's observations on the "correlative constitution" of the neurological body before the "apparatus of neurological capture" (*les dispositifs de capture neurologique*)," I argue for the importance of analyzing the role of media/mediation as integral to this correlative constitution.[4] Finally, I provide early twentieth-century examples of studying the human brain – both imagined and actual practices – in which new media played an important part. It is in this moment of convergence, when different mediated correlations accumulated, I contend, that we discern the nascent understanding of the active, living brain as a "live brain."

Nervous subject, modern sensorium

Printed without a source reference in 1920, the image of the writing woman and her brain served as an illustration in Warren Hilton's motivational self-help guide *Applied Psychology: Making Your Own World*, part of a series of no less than twelve volumes on "the Applications of Psychology to the Problems of Personal and Business Efficiency," published between 1919 and 1920 by the Society of Applied Psychology under the auspices of the American publisher *The Literary Digest* (also founded by Hilton). [5] The volumes promised to teach their readers new "mental methods" for an "efficient use of the mind" in the modern work environment.[6] Hilton's books were advertised as applied psychology (his work was particularly influenced by "New Thought," American motivational literature from around 1900), a heterogeneous discipline that maintained only loose connections to other branches of psychology, such as experimental psychology.[7] Although the author briefly invoked "facts (…) by experiments from psychological physiology,"

[4] "dans la constitution corrélative d'un corps neurologique en face de ce regard et de ce dispositif de capture," Michel Foucault, *Le Pouvoir Psychiatrique : Cours Au Collège De France, 1973-1974*, Hautes Études (EHESS/Gallimard/Seuil, 2003), 301.

[5] Warren Hilton, *Applied Psychology: Making Your Own World: Being the Second of a Series of Twelve Volumes on the Applications of Psychology to the Problems of Personal and Business Efficiency* (New York: the Literary Digest for the Society of Applied Psychology, 1920), 16. [While I cannot ascertain the print run of these twelve volumes (of over 1100 pages), it is likely that the series was widely distributed and ran through many editions. They were advertised at least until 1930. In fact, they are still available in reprints today.]

[6] Ibid., 4.

[7] As Nadine Weidman has pointed out, when applied psychology (a hybrid field of psychologists advising advertising firms and working on vocational tests and worker efficiency) rapidly developed as a separate branch, "a coalescence of psychology and neurology mattered less and less," and "applications could work without any understanding of or attention to the biological basis of behavior." Nadine M. Weidman, *Constructing Scientific Psychology: Karl Lashley's Mind-Brain Debates* (Cambridge: Cambridge University Press, 1999), 14.

there was little mention of neurophysiological or neuroanatomical science.[8] Applied psychology itself was a contested field. In 1920, as historian Michael Sokal notes, one prominent applied psychologist, Walter Van Dyke Bingham, worried about pseudo-scientific branches such as the abovementioned Society of Applied Psychology, "whose president, Warren Hilton, was acquainted with the science of psychology only through one undergraduate course in the area at Harvard."[9] (Hilton indeed credited Harvard scholar Hugo Munsterberg as one of his sources of inspiration.) In Hilton's book, the image of the brain functioned as a gesture towards scientific authority and signaled some biological facts supporting his advice for mind improvement. On the relation between brain or nerve-cell activity and mind, he remained rather agnostic, simply stating that mixing the two registers was "incompatible with scientific methods," and that his readers should be "investigating the mind, not the body."[10]

Hilton's work is evidence of the persistent importance of a heterogeneous domain of mental sciences or psycho-analytics in the early decades of the twentieth century (dispersed and appropriated in fields of psychical research, psychotherapy, and management consulting, for example) that continued to conceptualize thought in terms of "nerve force," "mental power," and "nerve exhaustion." This conception of the nervous system in terms of a battery, of a "nervous economy" of force that could be depleted or re-energized, had been popularized by George Beard's study *American Nervousness* in 1881 and spurred different versions of the idea of "neurasthenia" (nervous exhaustion) in local research cultures across the globe.[11] Beard's neurasthenia was the pre-eminent condition of (often male) modern city dwellers, "brain workers" equipped with a human sensorium (a nervous system extended into the world by the senses) that was constantly exposed to – as well as networked with – the intense stimuli coming from new (media)-technologies so prevalent in their modern surroundings.[12]

[8] Hilton, *Making Your Own World*, 17. In the introduction to *Applied Psychology* Volume I, Hilton printed a list of more than a dozen scholars who influenced his thinking (but did not reference them directly anywhere else), including psycho-technical researcher Hugo Munsterberg, experimental psychologist Joseph Jastrow, psychologist Pierre Janet, and other self-help authors, applied psychologists, psychical researchers, intelligence testers, management consultants, "New Thought" thinkers, experimental psychologists, and therapists. *Applied Psychology: Psychology and Achievement. Being the First of a Series of Twelve Volumes on the Applications of Psychology to the Problems of Personal and Business Efficiency* (New York: the Literary Digest for the Society of Applied Psychology, 1919), Prefatory Note.

[9] Michael M. Sokal, "The Origins of the Psychological Corporation," *Journal of the History of the Behavioral Sciences* 17, no. 1 (1981): 57.

[10] Warren Hilton, *Applied Psychology: Mind Mechanism. Being the Eighth of a Series of Twelve Volumes on the Applications of Psychology to the Problems of Personal and Business Efficiency* (New York & London: the Literary Digest for the Society of Applied Psychology, 1920), 27.

[11] Marijke Gijswijt-Hofstra and Roy Porter, *Cultures of Neurasthenia from Beard to the First World War* (Amsterdam: Rodopi, 2001).

[12] Andreas Killen, *Berlin Electropolis: Shock, Nerves, and German Modernity* (Berkeley: University of California Press, 2006), 42; Jeffrey Sconce, *The Technical Delusion: Electronics, Power, Insanity* (Durham: Duke University Press, 2019), 195.

By the 1920s, neurasthenia had gradually waned as a diagnostic label in scientific communities in a number of countries, viewed as too much of a blanket category that did not take biological and psychological facts into consideration.[13] And yet, elements of neurasthenic thinking remained: a relational conception of the modern experience, of the intimate and vulnerable connection between sensorium and environment. Within this conception, modern technologies offered analogies for the human nervous system (for its speed, communication, and movement) and the other way around: new conceptions of nervous matter (as a network and as transporting signals by means of energy) also shaped the way the relation between nervous subjects and their social world could be thought.[14]

This neurasthenic conception of a media-networked modern nervous subject was still very much present in *Making your Own World* in 1920. Like previous motivational business literature, Hilton sketched a very contemporary image of the working nervous system in its modern environment: it was a world brimming with activity, where "at the busy corner of a city street," "light, sound and tactual vibrations press upon you from every side," always "titillating the unsleeping nerve-ends of the sensorium."[15] The brain is portrayed as a "central office," that could only be reached after messages passed through an infinitesimal number of nerve cells.[16] The nervous system worked like the transmitter of a "human telephone" that connected to the world, and the mind functioned as "the receiving apparatus of the wireless telegraph," picking from the air only those vibrations "to which it is attuned."[17] The modern (male) worker could best navigate this busy world by being selective, the book claimed. Selection was the key to "making your own world": conscious mental acts were necessary to attune the mind to only to those parts of the environment conducive to productivity. Consequently, judgement and conduct would be "made up" of specifically selected mental pictures of the environment only, they were they were part and parcel of your own mind: "*Your environment is within you.*"[18]

The functioning of the brain or the nerves was thus not discussed in anatomical terms, it was inscribed in a broader metaphorical circuit that connected everyday media technologies and sensory experience. The modern human subject – equipped with a nervous system connected to

[13] Tom Lutz, "Varieties of Medical Experience: Doctors and Patients, Psyche and Soma in America," in *Cultures of Neurasthenia from Beard to the First World War*, ed. Marijke Gijswijt-Hofstra and Roy Porter (Amsterdam: Rodopi, 2001), 59.
[14] Salisbury and Shail, *Neurology and Modernity: A Cultural History of Nervous Systems, 1800-1950*, 10.
[15] Hilton, *Making Your Own World*, 21.
[16] Ibid., 14.
[17] Ibid. While Hilton never credits New Thought writer William Walker Atkinson, this passage on the wireless receiver clearly seems copied from William Walker Atkinson, *Nuggets of the New Thought; Several Things That Have Helped People* (Chicago: The Psychic Research Company, 1902). Cited in Sconce, *The Technical Delusion*, 208.
[18] Hilton, *Making Your Own World*, 59.

the outside world via the senses – was understood as always already caught up in a media-saturated environment. In fact, the term "media" must be understood as having its own historicity: it did not always mean a technological "medium" (an instrument or system such as a radio or television, as we use the term today, in fact, it did not have this meaning in 1920). A particularly important meaning – present in the work of a number of theorists at the time – is that of media as the material-technical environment in and through which perception takes place and is itself altered (what Walter Benjamin had started envisioning in the 1920s and later discussed as the "medium of present-day perception" and the "apparatus of apperception").[19] The biological senses of the modern citizen were viewed as literally changed by the omnipresence of media technologies, becoming part of a network of mediation, and by this process the nervous system and the senses were newly articulated and conceptualized vis-à-vis such modern media technologies.

Combining an altered photograph with drawn imagery, the figure of the writing woman is characteristic of the cut-and-paste methods of early twentieth-century photomontage, a technique that was favored by emerging popular-science journals and magazines in the USA and Europe.[20] Generally, the early decades of the twentieth century were characterized, as Cornelius Borck has noted, by a conjunction of the increasing "scientification" of everyday phenomena (scientific research into quotidian phenomena like work environments, diet, clothing, sleeping habits, and mental testing), as well as the emergence of new public sites and media where science was experienced, negotiated, and also challenged by both scientists and laypeople (newspapers, radio, popular magazines and science exhibitions for example).[21] Hilton's book, for example, noted that "through the writings of lay-men the popular mind has become befuddled with vague and speculative explanations of the facts."[22] Research about the brain – and the status and authority of

[19] Walter Benjamin and Michael W. Jennings, "The Work of Art in the Age of Its Technological Reproducibility [First Version]," *Grey Room*, no. 39 (2010 [1935]): 11–38, 15, 33. On changing conceptions of "medium" and "media," see Antonio Somaini, "Walter Benjamin's Media Theory: The Medium and the Apparat," ibid.62 (2016); John Guillory, "Genesis of the Media Concept," *Critical Inquiry* 36, no. 2 (2010). On 'mediation' see Raymond Williams, *Keywords: A Vocabulary of Culture and Society* (New York: Oxford University Press, 1976), 204-7.

[20] Cornelius Borck, "Communicating the Modern Body: Fritz Kahn's Popular Images of Human Physiology as an Industrialized World," *Canadian Journal of Communication* 32, no. 3 (2007); Matthew Biro, "The New Man as Cyborg: Figures of Technology in Weimar Visual Culture," *New German Critique*, no. 62 (1994).

[21] Borck describes this as a shift from the nineteenth-century "experimentalization of life" (the transformation of life's processes into phenomena that could be experimentally observed in laboratories) to the "experimentalization of everyday life" in the twentieth century. Borck, *Brainwaves*, 119; Hilton, *Applied Psychology: Mind Mechanism. Being the Eighth of a Series of Twelve Volumes on the Applications of Psychology to the Problems of Personal and Business Efficiency*, 38.

[22] The book cautioned that various present-day authorities had falsely equated mind-facts and brain-facts, "explanations that may actually be true, but are in the very nature of things incapable of proof and are utterly out of place in a scientific study of the subject. They are excursions into the dream forest of mysticism, occultism and religion." *Applied Psychology: Mind Mechanism. Being the Eighth of a Series of Twelve Volumes on the Applications of Psychology to the Problems of Personal and Business Efficiency*, 37.

such research – was conveyed and disputed within new contexts (and through new forms) of popular mediation.

Looking closer at the image of the writing woman also reveals what was left of more than fifty years of studying the relation between living humans and their brains: blots and lines. The dashed lines stemmed from reaction-time experiments, started in the nineteenth century by psycho-physiologists measuring the time it took from stimulating a nerve or a subject to its response, while the blots hailed from nineteenth-century *Zentrenlehre* localizing cerebral functions spatially in the brain.[23] In fact, this photomontage was an appropriation of an earlier cross-section drawing of a writer's brain: that writer was holding a feather quill (hence that outmoded quill in the hand of the woman). Produced by famous neurologist Jean-Marie Charcot and his co-researcher Pierre Marie in 1883, it was part of a project that correlated behavioral abnormalities (such as speaking difficulties in aphasic patients) with post-mortem brain observations, resulting in a diagram of four different cerebral centers involved in the production of oral and written language.[24] [Figure 1.2]

Blots and lines, these came from the two important nineteenth-century traditions of temporal-oriented psycho-physical research and spatial-oriented cerebral-lesion research that intersected and were superimposed in this photomontage of a transparent female brain-body. And yet, by the early 1900s, both these methods had failed to produce the desired outcomes: though the field of psycho-physiology aimed to find the exact time measurements for psychological processes, laboratories worldwide only reported disparate results by the 1890s.[25] And by 1906, Pierre Marie had started to doubt his work on localization and drove a "pickaxe into the edifice of aphasia," as one researcher later described it.[26]

[23] On the history of psychophysiology, see Henning Schmidgen, *Hirn Und Zeit: Die Geschichte Eines Experiments 1800-1950* (Berlin: Matthes & Seitz Verlag, 2013); "Die Geschwindigkeit Von Gefühlen Und Gedanken," *NTM International Journal of History & Ethics of Natural Sciences, Technology & Medicine* 12, no. 2 (2004). On the history of the *Zentrenlehre* see Guenther, *Localization and Its Discontents*.

[24] Pierre Marie, "Revue Général De L'aphasie (Cécité Verbale, Surdité Verbale, Aphasie Motrice, Agraphie)," *Revue de Médecine* 3 (1883); "De L'aphasie En Général Et De L'agraphie En Particulier, D'après L'enseignement De M. Le Professeur Charcot," *Progrès Médical* 7, no. 5, deuxième serie (1888). Cited in Victor W. Henderson, "Alexia and Agraphia," *Neurology* 70, no. 5 (2008). Charcot's image in turn had been based (among other research) on the lesion research and brain mapping of Sigmund Exner: *Untersuchungen Über Die Localisation Der Functionen in Der Grosshirnrinde Des Menschen* (Wien: W. Braumuller, 1881).

[25] Ruth Benschop and Douwe Draaisma, "In Pursuit of Precision: The Calibration of Minds and Machines in Late Nineteenth-Century Psychology," *Annals of Science* 57, no. 1 (2000): 24.

[26] A. Souques, "Quelques Cas D'anarthrie De Pierre Marie. Aperçu Historique Sur La Localisation Du Langage," *Revue Neurologique* 2 (1928): 362. Cited in Harrington, *Medicine, Mind, and the Double Brain*, 261.

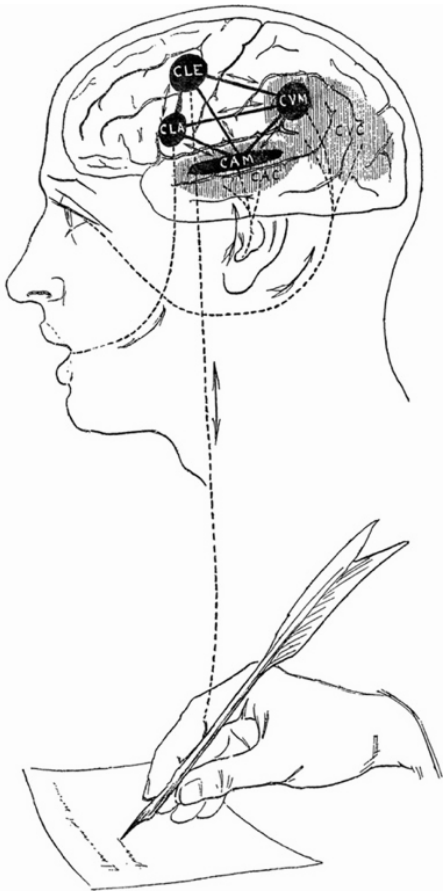

Figure 1.2 Charcot's scheme for interconnected left hemisphere cortical centers involved in oral and written language, c. 1883 (illustration)

In the last decades of the nineteenth century and at the turn of the twentieth, brains were thought to matter for explaining human behavior and human minds, but *how* (in what relation to the living human) and *to what extent* they mattered changed in zigzagging movements. Historians of brain science such as Anne Harrington, Susan Leigh Star, and Katja Guenther trace these differing conceptions, predominantly in the late nineteenth century.[27] Their important studies have deepened our understanding of the correlative practices of brain research, revealing the rise of more complex models of the interrelations between living bodies and cerebral lesions (dynamic and connectionist models, for example). The end of the nineteenth century represented a shift, as temporal (psycho-physical) and spatial (anatomical localization) approaches were offering inconclusive results. The correlative project – correlating (through different emphases and systems) the living body's behaviors, utterances, and jitters with physiological data and observations of dead brains and bodies – continued but was approached with particular uncertainty.

[27] *Medicine, Mind, and the Double Brain*; Susan Leigh Star, *Regions of the Mind: Brain Research and the Quest for Scientific Certainty* (Stanford: Stanford University Press, 1989); Guenther, *Localization and Its Discontents*.

Paying attention to the late nineteenth-century history and historiography of brain research helps to understand the beginnings of a configuration of knowledge that underlies the shift to the "live brain." I trace this shift using Michel Foucault's work on the history of medicine and psychiatry as it developed through his writings: from his mention of the skull-breaker in 1820 in the preface of *The Birth of the Clinic* (1963), through his description of the emergence of a new "neurological body" in the 1860s, leading up to the disappointments of trying to understand the post-mortem brain and localizing cerebral lesions towards the end of the nineteenth century, described in Foucault's lectures (1973–1974) and published as *Psychiatric Power*. I follow the development of his historical concepts from his archaeologically oriented work to his later genealogically oriented writings, ending with his references to the final decades of the nineteenth century. In the process, I will make an argument for a media-sensitive understanding of the "apparatus of neurological capture," allowing me to return, via Foucault, to the writer at her desk.

Foucault's "apparatus of neurological capture"

First, the skull-breaker. This "*casse-crâne*" figures as the emblematic example in the preface of *The Birth of the Clinic*, a study in which Foucault describes the emergence of a new "anatomo-clinical gaze" in the nineteenth century.[28] This gaze, a new way of seeing and saying enabled by a new configuration of practices and discourses, allowed for the correlation of visible clinical symptoms with hidden views of the human interior, of the body that had been concealed but could become accessible, post-mortem, through autopsy.[29] Foucault finds exemplars of this new gaze in Francois Lallemand's act of hammering open the skull in 1820 and in Antoine Bayle's 1825 attempt to understand the pathology of hysteria through careful description of brain lesions.[30] The skull-breaker and his cerebral descriptions form the start of the fundamental spatialization and verbalization of the pathological. Within this new epistemological structure, truth was revealed by probing invisible structures, by spotlighting that which tried to evade the eye.[31] Yet, while here the skull-breaker seemed to offer a new understanding of pathology by opening up the patient's brain to anatomo-clinical perception, in his later writings Foucault would signal the eventual let-down of

[28] Michel Foucault, *The Birth of the Clinic: An Archeology of Medical Perception* (Tavistock, 1976), 146.
[29] Ibid., 159, 49. Anatomo-clinical perception aimed for the inaccessible, "enclosed world of bodies" via the "point of view of death." Ibid., 169.
[30] François Lallemand, *Recherches Anatomico-Pathologiques Sur L'encéphale Et Ces Dépendances* (Paris: Imprimerie de Baudouin Frères, 1820), vii, n; A.L.J. Bayle, *Nouvelle Doctrine Des Maladies Mentales* (Paris: Gabon et Compagnie Libraires, 1825), 23-4.
[31] Foucault, *The Birth of the Clinic*, 166. Foucault refers to this new "structure" or "figure" of the medical gaze as "invisible visibility" or as the "visible invisible," a gaze that is directed by the potential of rendering visible the body's hidden content, both through revelations by the scalpel and by the activity of meticulous medical description, i.e. by the "work of language in pursuit of perception." Ibid., 169.

cerebral visibility, of trying to understand patients' strange behavior by examining their brain post-mortem. Dead brains could hardly be mapped onto living patients. The relation between the visible and the invisible, between surface and depth, seemed to unravel when it came to understanding the brains of the living.

In *Psychiatric Power*, Foucault describes the emergence of a new gaze around the 1860s, a "neurological gaze" instigated by new patient-doctor encounters in the neuro-psychiatric clinic, with Jean-Martin Charcot and the Paris Hôpital de la Salpetrière in the 1880s as his main example. This "new clinical apparatus of neurological capture," thus offered the "discovery," in a Foucauldian sense, of a "neurological body."[32] The practice of cerebral localization, he describes, now becomes subsumed within a broader neuro-psychiatric apparatus that systematized the recordings of both the "surfaces" of patients (their attitudes, their movements, their utterances) as well as post-mortem studies of their insides: body and brain. He thus describes the "correlative constitution" of a neurological body before the neurological clinic's gaze and apparatus of capture.[33]

Foucault notes various ways in which anatomical localization and neurological observation were correlated or "matched up" (*ajuster*) in the nineteenth century.[34] Even when "organicist" (brain-based) explanations of pathology intensified at certain moments, he shows that such projects always interconnected with broader systems of symptomatology or nosography. He cites Jean-Martin Charcot, who celebrated, in 1879, "the spirit of localization" that would show anatomical structure of the nervous centers "in their true light."[35] Yet such high hopes did not always mean that localizing function within the space of the brain was science's ultimate conceptual horizon, or at least that it did not need to be in practice. Adding to Foucault's account, I note here briefly that the example of Charcot aptly shows this complexity. Charcot used the term "dynamic lesion" to describe pathological signs in the living body that he conceptualized as being on the threshold of visibility, a marginal space of potential future visualization.[36] Sometimes he would argue that these lesions did not leave visible post-mortem traces in the brain, but could only be inferred by studying the performing, living body. Other times, he suggested that they escaped present means of

[32] "The emergence of the neurological body, or rather, of the system constituted by neurology's clinical apparatus of capture and the correlative neurological body." *Psychiatric Power: Lectures at the Collège De France, 1973--1974* (New York: St Martins Press, 2008), 307.
[33] Ibid., 299.
[34] Ibid., 297.
[35] Jean-Martin Charcot, "Faculté De Médecine De Paris: Anatomo-Pathologie Du Système Nerveux," *Progrès Médical*, no. 14 (1879): 161. Cited in Foucault, *Psychiatric Power*, 324.
[36] Marshall, J. W. (2016). Performing Neurology: The Dramaturgy of Dr Jean-Martin Charcot. New York: Springer, 58. Kaitaro, T. (2001). Biological and Epistemological Models of Localization in the Nineteenth Century: From Gall to Charcot. Journal of the History of the Neurosciences, 10(3), 262–276, 273.

anatomical investigation but would become materially registerable in the future, eventually becoming visible. Foucault's research, in tandem with more recent histories of the brain, makes the important point that cerebral-lesion research must always be viewed as part of broader conceptions of symptoms or conditions, as part of a broader discourse on the potential somatization (and visibility) of mental pathology.

In his analysis of the apparatus of neurological capture in *Psychiatric Power*, Foucault is most invested in describing the power relations between neurologists and patients, "a whole battery" of "arrangements" through which patients were instructed and forced to respond to neurologists.[37] He recounts that by recording those responses and bringing them together with insights from different fields (including cerebral-lesion research), researchers around 1860 worked towards a "system of signs" that distinguished one type of jittering or mumbling in a patient from another and thus allowed for the creation of a systematic and detailed symptomatology of the neurological body, what he calls "differential diagnosis."[38]

In his observations on Charcot's clinic, Foucault notes the "arrangements" of relations of force that were designed for this differential diagnosis, including the spaces in which the examinations of patients were performed in front of and audience, yet he pays only partial attention to the technological devices and uses thereof that were integral to differential diagnosis. While he notes the importance of charts, descriptions, and classifications as part of the apparatus of neurological capture, Foucault barely traces the way Charcot, Duchenne, and other Salpetrière researchers developed many technologies of demonstrative truth – photography, chronophotography, microphotography, sketches, and wax figures – that were also part of the correlative apparatus. After Foucault, numerous historians have pointed to Charcot's photographic methods as representing the pinnacle of his differential-diagnosis project; the felt immediacy of photographic records guaranteed the truthfulness of the psychiatric practice.[39]

These types of media-assisted diagnosis also needed to be *performed* – through specific repertoires and in specific spaces – to be brought in relation to one another and in correlation with the patient. Salpetrière's infamous demonstrations of hysteric and other nervous patients were part of lectures in which Charcot expounded on the symptomatology of cases, drawing together the

[37] Foucault, *Psychiatric Power*, 300; ibid., 298.
[38] Ibid., 301. Through neurological analysis, gestures, movements, and moods could be ascribed to (differing degrees of) voluntary or involuntary behavior, automatic responses, or intentional attitudes. Hence, this differentiation could finally allow the neurologist to separate genuine illness from simulation.
[39] Sander L. Gilman, *Seeing the Insane* (Lincoln: University of Nebraska Press, 1996), 195; Ulrich Baer, "Photography and Hysteria: Toward a Poetics of the Flash," *The Yale Journal of Criticism* 7, no. 1 (1994); Georges Didi-Huberman, *Invention De L'hystérie : Charcot Et L'iconographie Photographique De La Salpêtrière*. (Paris: Macula, 1982), 50; Sander L. Gilman, "The Image of the Hysteric," in *Hysteria Beyond Freud*, ed. Sander L. Gilman (Berkeley: University of California Press, 1993).

different elements of his diagnosis.[40] These lectures were attended by medical scientists as well as a changing audience of affluent Parisians from intellectual and artist circles (such as actress Sarah Bernhardt), and took place in a room that could easily be darkened or illuminated, and was equipped with an slide projector. Immediately after a patient left the room, Charcot could project a picture or a sketch of a microscopic brain-lesion image that corresponded to the patient's symptoms, a connecting gesture that allowed for a correlation between the living body and a documented brain.[41]

It is in this arranged situation of juxtaposition, this superimposition of living bodies and imaged brains, that I propose we see the beginnings of a new configuration. By giving more attention to the emergence of media technologies, and the way such technologies needed to be performed in particular assemblages, we can see the *correlative constitution* not only of a neurological body, but also of an emerging conception of seeing an active, living brain.

Before I expound on this, I want to draw special attention to this correlation "performance" through technological media by means of a diversion into Foucault's life. Foucault did not pay particular attention to (media-)technical apparatuses of capture, even though he himself was immersed in a range of such technologies when he helped administer psychological tests to French prisoners in the early 1950s (as part of an EEG research team run by Georges and Jacqueline Verdeaux at Paris' St. Anne hospital).[42] Cornelius Borck, reflecting on this biographical detail, remarks that Foucault may have viewed EEG as just one example of a broader practice of building new classifications (separating the insane, epileptics, women, or geniuses, for example), part of his tracing a broader "operational mode of scientific discourse" based on exclusion and monitoring.[43]

Notwithstanding Borck's observation, a closer look at the research in which Foucault was involved shows a special preoccupation with creating a system of differential diagnosis preeminently based on (the combination of) new recording technologies as well the performance

[40] In Charcot's words, one had to continuously gather "the laboratory work and the autopsy of the amphitheatre."Jean-Martin Charcot, *Tome V. Maladies Des Poumons Et Du Système Vasculaire*, ed. Désiré-Magloire Bourneville, Oeuvres Complètes (Progrès médical, 1888), 6. Cited in Jonathan W. Marshall, *Performing Neurology: The Dramaturgy of Dr Jean-Martin Charcot* (New York: Springer, 2016), 52. "Charcot's dramaturgical project constituted a form of reverse-dissection, a reconstruction of the anatomized body within the lecture theatre, drawing physiological conclusions from the fragmentary anatomical data arrayed within its space. Here patient and specimen confronted each other. The demonstrator's task was to integrate this material within a composite, virtual, nosological body." (ibid., 32.)

[41] *Performing Neurology*, 86. "The years 1894–1900 also saw the production of the first radiographs, electrocardiographs, and even so-called "phonocardiographs" at the Salpêtrière." Ibid., 243.

[42] Didier Eribon, *Michel Foucault* (London: Faber & Faber, 1993), 87; David Macey, *Michel Foucault* (London: Reaktion Books, 2005).

[43] Borck, *Brainwaves*, 183-4. Borck warns about a too "big-picture description" in historicizing the quantifying procedures in the life sciences, such as EEG-research, sweepingly, as a "topos of biopolitics," which would risk a certain presentism.

of these recordings. In 1955, the Verdeauxs proposed a "*technique de polygraphie*," a procedure that asked subjects to respond to audio and visual stimuli (Foucault's task was to operate the tachistoscope that flashed simple or complex figures) and that would record their responses on a sheet that registered EEG measurements as well as skin conduction, ECG, and respiratory rhythms.[44] This multi-record would then be projected for the psychiatrists by means of an epidiascope as sound tapes of the corresponding subject played simultaneously. Ultimately, this polygraphy would result in, as the authors put it, "reproducing the experience over time, and reliving it, in a way, in the subject's absence."[45] Such a "relived" demonstration would allow psychiatrists to conduct their interrogations more precisely, by means of "objective indications."[46]

This polygraphy proposed both an assembled technology as well as a specific way of performing diagnosis by means of projection through the epidiascope (the same technology used in 1934; see the Introduction's prelude). As such, it signaled a correlative constitution of the neurological body that emphasized the possibility for newly assembled (and performed) relations between living patient and physiological record. Through the simultaneous superimposition of various technologies, the living body and active brain could be "relived." Reading Foucault's 1955 work now should incite us to pay more attention to media technologies, and to be especially sensitive to the powers media have in shaping the discourse on categorizing brains and psychiatric patients, as well as to how such discourses shaped new media and assemblages of media and bodies through performances of knowledge.

Examining and imagining the living brain

Imaginaries of invading the skulls of living people by means of new technological media were prevalent at the same time that the project of the neurological apparatus of capture was plagued by disappointment. At the end of *Psychiatric Power*, Foucault's narrative of the neurological gaze ends in failure: "the neurological body, like the body of pathological anatomy, will elude the psychiatrist"; this was the "disappearance of the great neurological hope."[47] At the end of the nineteenth century, many neurologists felt it would be impossible to arrive at a differential diagnostics, and they particularly saw the project of cerebral localization as unsatisfactory.[48] Even

[44] G. Verdeaux and J. Verdeaux, "Description D'une Technique De Polygraphie," *Electroencephalography and Clinical Neurophysiology* 7, no. 4 (1955): 647.
[45] Ibid.
[46] Ibid.
[47] Foucault, *Psychiatric Power*, 288.
[48] Anne Harrington, "The Brain and the Behavioral Sciences," in *The Cambridge History of Science: Volume 6, the Modern Biological and Earth Sciences*, ed. Peter J. Bowler and John V. Pickstone (Cambridge/New York: Cambridge University Press, 2009), 519.

the well-known neurologist Carl Wernicke, famous for his pioneering diagram of aphasia in the brain, moved away from the localization project.[49] Where scientists had been preoccupied with indicators of the functioning brain and nervous system that were at the threshold of visibility – almost invisible, but perhaps legible in minute gestures, micro-lesions, or milliseconds – now it seemed that the functional mechanisms of living organisms were beyond neurologists' ability to register.[50] Perhaps it was not the careful description of jittering and mumbling bodies, nor cerebral lesions traced after death that would yield final conclusions about the functioning of the active brain.

At the turn of the century, some researchers turned away from questions of visibility. Sigmund Freud did so with psychoanalysis, for example. In 1896, Henri Bergson downplayed the role of the physical brain and criticized localizationist theories by saying that "the brain is nothing but a kind of central telephone switchboard," "it adds nothing to what it receives."[51] Yet whatever minor or major role was attributed to the brain, clearly the organ had become part of a sensorium and vocabulary that was fully media-saturated. Modernity's shocking "media ubiquity," as it is now commonplace for historians to say, had by then also firmly established the idea that new media assemblages could or would eventually produce any imaginable record of the surface of the living body (through photography, graphic inscriptions, or cinematography, for example) and even its invisible insides (by microphotography, microcinematography, x-rays, for instance).[52] The living brain had long been imagined as the final frontier, the ultimate realm for new media to conquer.

Nineteenth-century scientists and fiction authors had fantasized about illuminating the skull or measuring nerves through "cerebroscopes," "brain mirrors," and "neurometers."[53] Take, for example, the "encephaloscope" dreamt-up by a French surgeon in 1884, which would make the skull transparent and project brain processes for everyone to see.[54] Or Thomas Edison, who in

[49] Wernicke developed new clinical demonstrations (*Krankenvorstellungen*) to interpret the gestures and utterances of neurological patients in relation to established pathological anatomical knowledge. See Guenther, *Localization and Its Discontents*.

[50] They were, in the words of a neurologist cited in 1905, "far below par." Cited in Cartwright, *Screening the Body*, 64.

[51] On Bergson's involvement and influence in the aphasia debate, see Arthur Benton, "Bergson and Freud on Aphasia: A Comparison," in *Bergson and Modern Thought*, ed. Pete A. Y. Gunter and Andrew C. Papanicolaou (London & New York: Routledge, 2016).

[52] Colette Colligan and Margaret Linley, "Introduction: The Nineteenth-Century Invention of Media," in *Media, Technology, and Literature in the Nineteenth Century: Image, Sound, Touch*, ed. Colette Colligan and Margaret Linley (Farnham, Surrey; Burlington, VT: Ashgate Pub. Company, 2011), 5; Hagner, *Der Geist Bei Der Arbeit*, 270; Robert Michael Brain, *The Pulse of Modernism: Physiological Aesthetics in Fin-De-Siècle Europe* (Washington: University of Washington Press, 2015), xxii. On surface readings of the neurological body, see Cartwright, *Screening the Body*, 73.

[53] Hagner, *Der Geist Bei Der Arbeit*, 223-35. A Neurometer was first listed by the OED in 1850. Oxford English Dictionary, *"Neurometer, N."* (Oxford University Press).

[54] Eduard Albert's encephaloscope, mentioned in Michael Hagner, "Mind Reading, Brain Mirror, Neuroimaging-Insight into the Brain or the Mind," in *Psychology's Territories: Historical and Contemporary Perspectives from Different Disciplines*, ed. Mitchell Ash and Thomas Sturm (London & New York: Routledge, 2007), 288.

1896 proclaimed that he would soon be able to produce an x-ray of the working brain inside the skull.[55] Or Richard Slee and Cornelia Atwood Pratt's fictional neurobiologist Dr. Berkeley, whose invention could turn brain slices into film strips that could be projected on a large screen.[56]

Interacting with these experimental and imagined (media-)technical assemblages and enabled by new (and imagined) technologies of visualization and graphic inscription, the 1900s and 10s saw the emergence of a plethora of experiments attempting to find new ways to correlate organic matters and the behavior of living humans. If Charcot imagined his patients' dynamic lesions as being on the threshold of visibility – in the space of the potentially visible – now this threshold had not been crossed but widened: new technologies promised new ways of arriving at a correlative constitution of the active, living brain.

At the end of the nineteenth century and the beginning of the twentieth, a new conceptualization of accessing the living, active brain emerged through a back and forth between brain experiments and fictional and scientific media imaginaries. In the domain of psychophysiology (also called experimental psychology) the project of correlating living bodies and mental processes remained a guiding premise. Numerous graphic curves, sometimes referred to as "braincurves," were registered to study the potential correlates of mental processes with, for example, breathing rates, electrical skin conductivity, muscular tension, pupil dilation, heartbeats, cerebral temperature, blood pressure, arterial pressure, or the metabolism.[57]

At the same time, the domain of nerve science saw, as historian Roger Smith puts it, an "advance of neurophysiology up the spinal cord and into the brain."[58] Especially striking were Otfrid Foerster's experiments in Germany in the aftermath of WWI that intervened into the bodies of living patients who had suffered headwounds. Through electrical probing, he set out to map the functional body onto the living brain and nervous system of these patients.[59] Foerster's project aptly shows how a new conception of the active brain emerged at the intersection and superimposition of a variety of technologies: anatomical drawings of the brain, photographic atlases of brain sections, film footage of neurological patients, filmed operations with new electrical

[55] As mentioned in N.A., "News and Notes," *The British Journal of Photography* (1896): 105.
[56] Richard Slee and Cornelia Atwood Pratt, *Dr. Berkeley's Discovery* (New York: G. P. Putnam's sons, 1899). See Flora Lysen, "The Brain Observatory and the Imaginary Media of Memory Research," in *Memory in the Twenty-First Century: New Critical Perspectives from the Arts, Humanities, and Sciences*, ed. Sebastian Groes (London: Palgrave Macmillan, 2016).
[57] For example in the work of Angelo Mosso, Charles Féré, Alfred Binet and Jules Courtier, Alfred Lehmann and later Hans Berger, (see R. D. Gillespie, "The Present Status of the Concepts of Nervous and Mental Energy," *British Journal of Psychology. General Section* 15, no. 3 (1925).) Antoni Jan Milkulski and Eufemjusz Józef Herman, "Die Hirnpulsation Des Mensen Auf Grund Experimenteller Untersuchungen," *Zeitschrift für Neurologie und Psychiatrie* 90 (1924).Also see Otniel E. Dror, "Techniques of the Brain and the Paradox of Emotions, 1880–1930," *Science in Context* 14, no. 04 (2001).
[58] Roger Smith, "Representations of Mind: C. S. Sherrington and Scientific Opinion, C.1930–1950," ibid., no. 4: 530.
[59] Probing nerves and brains by electrical currents to test their functionality, subsequently cutting tissues that caused epilepsy and motor impairments. Guenther, *Localization and Its Discontents*.

techniques, and photographs of patients' bodies covered with penciled marks and arrows denoting specific correspondences to the spinal cord.

Bodies and brains – and their interrelation – could be studied with, and imagined through, this array of newly superimposed technologies. Parallel to Foerster's assembled active nervous systems of living patients, numerous other projects contributed to new imaginations of accessing active brains. Think, for example, of Karl Reicher's strange animation of brain slices as a *Kinematografie der Neurologie* in 1906, or Emile Cohl's fiction film that used animated sequences to show mental processes in *Le Retapeur des Cervelles* (The Brain Corrector) in 1911.[60] Around 1913, physiologist Ivan Pavlov imagined a transparent brain with a moving spotlight indicating consciousness.[61] In the early decades of the twentieth century, it was not merely the ubiquity and variety of (media) technologies, but especially their new intersections and juxtapositions – recalibrating back and forth between findings – that allowed for the correlative constitution of the active brain – the idea that the living brain could be perceived in action. By employing Foucault's term "correlative constitution," I emphasize that it is never technology alone that brings about such correlations, but always technologies that are actively brought together, are *performed*, in specific instances, configurations, and assemblages.

Conclusions

We return to the writer at her desk in 1920. Looking into her head, we see a brain that emerged through different nineteenth-century research pathways of correlating living bodies and brains. Relating the photomontage to the text in Hilton's book, we also recognize a discourse on working brains in their modern surroundings as part of a human sensorium that was constituted by telephones and wireless receivers in a media-saturated environment. This was a brain populated with active, "alive" elements, a working brain that could be related, as Hilton's volumes on business psychology did, to "live wires" – a term that denoted not only wires with electrical potential, but also prodigious businessmen.[62] The image is but one example of a broader conception of the

[60] On Reicher's *"Kinematografie in Der Neurologie," Verhandlungen der Gesellschaft Deutscher Naturforscher und Ärtze (1908).* see Flora Lysen, "Grey Matter and Colored Wax," in *Textures of the Anthropocene: Grain, Vapor, Ray*, ed. Katrin Klingan, Ashkan Sepahvand, and Bernd M. Scherer (Cambridge, MA: MIT Press, 2015), 75.

[61] Ivan Petrovich Pavlov, *Die Höchste Nerventätigkeit (Das Verhalten) Von Tieren: Eine Zwanzigjährige Prüfung Der Objektiven Forschung ; Bedingte Reflexe. Sammlung Von Artikeln, Berichten, Vorlesungen Und Reden* (München: Verlag J. F. Bergmann, 1926), 203. Cited in Hans Berger, *Über Die Lokalisation Im Großhirn: Rede Gehalten Bei Der Akademischen Preisverteilung Zu Jena Am 18. Juni 1927; [Mit Einer Chronik Der Universität Für Das Jahr 1926/27]* (Jena: G. Fischer, 1927), 36.

[62] An example of the "live wire" men in "Home Furnishing Review," (Andrew J. Haire, 1916). "you have been examining the human body with the scalpel and the microscope of the anatomist and physiologist. In doing so and by watching the bodily organs in operation, you have learned that every part of the body to those organs commonly known as involuntary, is ultimately subject to the influence or control of consciousness, that part of the human intelligence which is properly known as "the mind." Hilton, *Applied Psychology: Psychology and Achievement. Being the First*

possibility of accessing the living brain that intensified, as I have recounted, with a range of twentieth-century (media) technologies to visualize cells and organs, to electrically probe the nerves and the cortex, to correlate mental activity with the active, living body, and to imagine the neurological human as always already mediated. It is this historical superimposition and intensification that allows me to call this new way of seeing and saying, around 1920, the emergence of the "live brain."

By pointing to the emergence of a live brain, I do not wish to argue that practices from disciplines including nerve research, psychophysiology, chemistry, neurology, neurosurgery, psychiatry, psycho-technics, and educational psychology were all converging towards a single point. Rather, I aim to describe the new way living bodies and brains were "matched up," to use Foucault's term, as part of a new discourse on modern subjects, and with a new confidence in being able to see the brain in action. In the early decades of the twentieth century, this happened even when no well-defined correlates of mental activity had been experimentally discovered. As we will see in Chapter 3, the development of EEG (starting with Hans Berger's experiments in the 1920s and culminating in his first paper on EEG in 1929) is an important moment in the history of brainmedia, since it is here that long-established imaginaries of electrical brains met a new scientific discovery on nerves' electrical activity. Yet, the "live brain" is not the result of the invention of EEG; rather, the development of EEG must itself be understood in interaction with these new cultural configurations.[63] A new way of seeing and saying arose, an assemblage of practices and discourses that allowed for the birth of the live brain.

Hence, in the 1920s, new discourses that located the modern subject amidst a media environment of ubiquitous recording and transmission served the conceptualization of an active brain as "live." This new live brain was an amalgam of older imaginaries of nerve telegraph wires, vibratory particles, and novel media technologies. It was live in the sense that its activity was understood both to be captured and characterized by a new immediacy and modern sensibility. More than ever, it was a brain that was understood to function as a (media) technology – immersed

of a Series of Twelve Volumes on the Applications of Psychology to the Problems of Personal and Business Efficiency, 115-16. "Live wire men" in *Applied Psychology: Initiative Psychic Energy. Being the Sixth of a Series of Twelve Volumes on the Applications of Psychology to the Problems of Personal and Business Efficiency* (New York: the Literary Digest for the Society of Applied Psychology, 1919). Volume 6, 57-58, "Not only is the living human body as a whole alive, but 'every part of it as large as a pin-point is alive, with a separate and independent life all its own; every part of the brain, lungs, heart, muscles, fat and skin.'" *Applied Psychology: Psychology and Achievement. Being the First of a Series of Twelve Volumes on the Applications of Psychology to the Problems of Personal and Business Efficiency*, 81.

[63] Cornelius Borck has expounded on Berger's frantic search for an ephemeral, potentially visible element of psychophysical energy since the late nineteenth century. Importantly, he shows there was no unidirectional path towards the electrical potential of nerves as correlate of mental processes. Even if there was a long-established conceptual and experimental link between electrical energy, psychic energy, and nerve research, Berger's experiments in the early decades of the twentieth century show many zig-zagging paths and alternative turns. See Borck, *Brainwaves*, 35-52.

in a back and forth between sensorium and environment. It was also *made perceptible* by media technologies. This live brain did not emerge from one new technology or discovery about the brain but must be viewed as the accumulated imaginary of a modern environment populated by media that changed the lived spatio-tempo-realities of daily life. It was at this moment that one could substantively start to imagine a working brain that acted in tandem with a working body as part of a working life – a live brain.