Making the Physical Real in the Psychical: How Intoxicants Intervened in the Formation of the Biological Subject in the Nineteenth Century

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This paper explores the formative role of substances of intoxication in the social and scientific establishment of the biological subject in late nineteenth-century Germany. Sourcing the emergence of substances of intoxication as "vital substances" from Brunonianism, this narrative traces their initial significance for Romantic physiology, followed by their rejection from neo-mechanical scientific physiology. Emphasis is placed on late nineteenth-century psychological research on the effects of intoxicants on the mind as the site of a dynamic encounter between theories of the mind and the body, particularly through Kraepelin's concept of intoxication as model psychosis, and his related research. The biological subject, here, is anti-vitalistic, and, yet, conceptually distinct from neo-mechanism.

One evening in the winter of 1877/1878, Emil Kraepelin, then still a junior psychiatric assistant, was anxiously preparing for his looming state exam, a task which saw him working long nights on sphygmographic studies (Kraepelin 1983).[1] Somewhere between mounting stress and the long hours, Kraepelin's waking and sleeping lives were quickly blending together. But Kraepelin had a solution. He promptly injected himself with 0.02 grains of morphine, about 20 mg., hoping to wake up refreshed the

1. The source text, Kraepelin's *Lebenserinnerungen*, provides an outlook on some aspects of Kraepelin's life which diverges in some cases from the reckoning of events established by modern Kraepelin scholarship, particularly that of Engstrom and Steinberg. Nevertheless, Kraepelin's memoir is an invaluable source of insight into the "quieter" events in Kraepelin's biography.

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following morning (Kraepelin 1983). Kraepelin never got the night's sleep he so desired. He took too high a dose and spent the entire night awake, nauseous and vomiting, before being rewarded the next morning with the first of many future migraines (Kraepelin 1983). By his own account, this was to his fortune; the experience may have spared him an eventual reliance that he had already seen afflict some of his fellow students (Kraepelin 1983). Nevertheless, this experience as a junior researcher may have changed the course of his life. Starting with his post-doctoral work in Wilhelm Wundt's Leipzig laboratory, research into the effects of intoxication on all kinds of mental states would become a virulent force in Kraepelin's experimental research for the better part of twenty years.

This is but one of the more banal vignettes in a much greater, overlooked tale in the history of the biological subject. The body as it has come to be understood in "the West," with both mind and body understood as a single, fleshy entity—as "biological"—is a relatively recent occurrence. As we have it, the story of the body, and especially the human body, comes to a head in the nineteenth century, when mechanists and vitalists became locked in a protracted struggle over the ultimate nature of organic matter. Darwinism is popularly credited with the finality of the shift away from vitalism, as well as mechanism, in the broader conception of not only the body but also the experience of embodiment. But what if this was only a fraction of the puzzle? Darwinism was, after all, initially a model of morphological shift, the bread and butter of German Romantic physiology. Further still, Darwin's framework provides no explicit or implicit critique of vitalism (or mechanism).

How did the body cease to be either (as La Mettrie put it) "a machine that winds its own springs" or a vivified entity, radically divorced from the inorganic world of salts and minerals, and instead become something of a marriage of both? (1748, p. 34)[2] After all, the biologistic conception of the subject clearly entails so much more than mere bio-genetic reductionism, as some continue to suggest (Lewontin 2003). Wherever it goes, the biological subject is supported by a sprawling baggage train of decidedly non-mechanistic actors—a mobile army variously comprised of treatment modalities, theories of mind, and newfound psycho-bodily forces, such as stress. If the biological subject refers to a subjectivity whose self-concept is to be understood in strictly physical terms, it appears to fundamentally differ from the kind of physio-chemical entity imagined by nineteenth-century neo-mechanism. What is the nature of this shift, and how did this idea take hold so quickly in the late nineteenth century? The answer, I propose, is intoxication, drunkenness, and inebriation. In a hazy dance that

2. [...] "une machine qui monte elle-même ses resorts."

spans the 18th and nineteenth centuries, I argue that it is the scientific encounter with substances of intoxication and their effects on the body (and mind) that ultimately gave rise to the biological subject toward the end of the nineteenth century.

Here I will be outlining the major developments in the history of this process. Starting with the development of late eighteenth-century scientific medicine out of experimentalist pharmacy, I establish the influence of John Brown's theory of excitability on early nineteenth-century Germany and the associated "vital substance concept." Thereafter, I situate the impact of this concept in the context of the debates between vitalists and neo-mechanists, understanding it as a conflict which severs the physiological conception of the body from the experience of embodiment. Finally, I demonstrate how late nineteenth-century research on the effects of intoxicants on the mind, led by Emil Kraepelin, ultimately form the bridge between the physiological body and the psychical experience of embodiment.

1. Vital Substances

Intoxicants began to serve a more prominent role in medical theory following the emergence of the official European pharmacopoeias over the course of the seventeenth and eighteenth centuries, as the growing interest in experimentalism brought many of the compound remedies of the *materia medica* under scrutiny.[3] By the time that Newtonian aspirations had taken root in the practical art of medicine, these established experimental practices in pharmacy would help structure some the varied eighteenth-century attempts at systematizing medicine. Of all the would-be founders of Newtonian medicine, the emphasis on pharmacy would be greater for none other than John Brown. The Brownian, or Brunonian, system of medicine, published in 1780, copied the model proposed by his teacher William Cullen, but with several important changes (Brown 1788).[4] The principle innovation of Brown's was the suggestion that the level of vital force, called "excitability," could be quantified by tracking and attributing weighted scores to a patient's activities and inputs (Brown 1788). Since vital force could not be quantified *in vivo*, it would be calculated as the

3. Other recent, and significant, pieces of scholarship in the history of pharmacy have considered developments outside of the central-European context. These are important discussions. The history of pharmacy is not exclusively, or even centrally, European; however, this narrative primarily focuses on the developments in the setting of central Europe.

4. The initial treatise was written in Latin and was later translated to English. Here I rely on the 1788 translation.

sum of scored bodily functions, and compared with a pre-established grading chart (Brown 1788). A continuum from 0–80 degrees, the chart's median value of 40 represented a state of perfect health, while those exceeding 40 where "sthenic," having too much excitability, and those below 40 were "asthenic" (Brown 1788). By Brown's report, in over ninety percent of cases the patient was asthenic, and thus in need of some form of vital stimulus (Brown 1788). Medicine then was about facilitating the depletion or increase in a patient's excitability and, for Brown, there were no more powerfully curative vital stimulants than opium and spiritous drink. Brown's claims regarding the efficacy of these remedies, as well as the idea for the entire medical system, were derived from his own experiences curing his gout with opium (Brown 1788). Intoxicants saved lives—stimulating the waning flesh of the sick and weary. They were, in effect, what I have dubbed "vital substances:" materials with a uniquely potent excitatory or vitalizing effect.

The Brunonian system never gained much of any popularity in Brown's native Britain, with the notable exceptions of Humphrey Davy, Coleridge, and De Quincey (Bergman 1991; Cooke 1974; Gao 2020; Golinski 2011; Morrison 1997).[5] However, it did attain a fantastic degree of popularity among the Germans. There, too, great efforts had been made to realize a systematic medicine, a scientific medicine, though Kant's restrictive definition of a proper science posed a lofty barrier. Bavarian physician Andreas Röschlaub saw Brown's system as satisfying Kant's criteria and put forward his own interpretation of Brunonianism in 1798, which he called *Erregbarkeitstheorie* (Röschlaub 1798; Tsouyopolous 1982). Brown's system, Röschlaub proposed, at least theoretically allowed for the quantification of health metrics and, though Brown's model was initially encountered with some hesitance in Germany, Röschlaub made it palatable by bringing the concept of Brownian excitability into accordance with Fichte's *Wissenschaftslehre* (Röschlaub 1799; Tsouyopolous 1988).[6] At the peak of its popularity, the Brunonian system, and with it the "vital substance concept" found supporters among physicians like Hufeland and Brühl-Cramer, chemists such as Johann Ritter, philosophers such as Immanuel Kant and Schelling, and, finally, *naturphilosophical* physiologists such as Lorenz Oken and

5. Davy even categorized his new discovery of nitrous oxide as a Brunonian stimulus. Notably, those listed here became interested in Brown via German sources.

6. Nelly Tsouyopolous (1988) argues that the success of *Erregbarkeitstheorie* can be attributed to a foundational conceptual similarity between Brown's system and Fichte's philosophy. Given that Schelling initially opposed Brownianism as too mechanistic, only to become a devout follower of Röschlaub, it would seem the determinative factor was Röschluab's interpretation of Brown along the lines of Romantic philosophy.

Schönlein (Brühl-Cramer 1819; Kielhorn 1996; Schelling [1799] 1858: 3; Schelling 1799; Tsouyopolous 1988).[7] Evidence of the vital substance concept can even be found in Friedrich Sertürner's discovery of not only morphine, but the entire class of alkaloids as a type of thing to be in the world (Sertürner 1817).[8]

An enduring testament to the sheer depth of Brunonianism's short-lived influence can be seen in the central place accorded to it in Schelling's and Oken's *Naturphilosophie*. They expanded upon Röschlaub's framework by integrating excitability into theories of organic activity, such as galvanism, further interpolating Brunonian ideas into the fundamental structures of the living cosmos. In his 1799 *Erster Entwurf eines Systems der Naturphilosophie*, Schelling positioned himself alongside Röschlaub and Brown in proposing that excitability was the first property of organic life (Schelling [1799] 1858: 3, p. 144). Excitability here referred to the underlying duality of the organic as both a subject, which constantly determines itself through activity, and as an object, something acted upon and maintained through external interaction (Schelling 1799). In this sense, excitability was simultaneously a description of the general activity of living beings, and of the experience of being a bodily subject (Schelling 1858).

Other theories of bodily activity were of considerable importance to *Naturphilosophie* as well. The significance of galvanism and animal magnetism, or mesmerism, are particularly well-known (Gantet 2021; Montiel 2009; Schelling 1858). For Schelling and his followers, galvanism and mesmerism were demonstrations of the fundamental symmetry of Being, each mirroring the inorganic phenomena of electricity and magnetism, respectively. Further still, the dialectical interplay between mesmerist and somnambulist was a realization of the unity between self and world, an image of vital action itself (Montiel 2009).[9]

7. Hufeland initially rejected the Brunonian system outright, in favor of his own holistic model; however, he eventually "wrote several articles about John Brown, in 1819, 1822, and 1829, and compared Brown with Galen" (Tsouyopolous 1988, p. 66). Hufeland also wrote the foreword for C. von Brühl-Cramer's Brunonian study on the phenomenon of *Trunksucht* (a proto-concept of alcoholism), calling the new illness *Dipsomania* (Brühl-Cramer 1819).

8. Sertürner would later openly identify with *Naturphilosophie*, but there is a strong case for Romantic influences earlier in his youth. Sertürner's 1805 "Säure im Opium" drew heavily upon Christoph Buchholz's "Versuche die Zerlegung des Opiums," and C. Buchholz was a Romantic chemist after the style of Wilhelm Buchholz, his uncle and Goethe's advisor (Maehle 1999; Partington 1962; Sertürner 1805). When first experimenting with his opium isolate, Sertürner describes the effects as stimulating the body (Sertürner 1817).

9. Gantet (2021) attributes Schelling's sudden interest in animal magnetism to the influence of his younger brother, Karl Eberhard Schelling.

Nevertheless, excitability, vital substances, and intoxication were evidently of, at the very least, comparable significance for early *Naturphilosophen*, as reflected in Schelling's use of opium's effect on the body as a principal example of bodily causation:

> That opium has an exciting effect is explained by its chemical, or, what is the same, its electrical nature (that is why it also works in galvanism), but its indirect effect, that is, the effect mediated by the activity of the organism itself, is narcotic, and this effect is of course chemically unexplained: because it is indirect. Thus, on the whole it is shown that the very same materials which cause the most violent excitability (which must be explained from their chemical and electrical properties) indirectly exhaust excitability (which, of course, can no longer be explained from their chemical properties). It's no wonder chemical explanations go no further than this. The ultimate effect of external causes on the organism can no longer be explained chemically. (Schelling 1858, p. 83)[10]

Opium's stimulatory capabilities are an entailment of opium's galvanic, and chemical properties, but opium's predominate effect, that of narcosis, reflects the more fundamental nature of excitability. Narcosis is neither chemical nor galvanic, but rather the perceptional expression of the bodily mediation of excess stimulation, the very occasion of an interface between individuated organism and nature. Excitability, in this sense, refers to the ongoing synthesis behind this duplicitous character of being a subject, of being both an actor and something acted-upon. As Schelling himself suggests, the "entire secret rests upon the on the opposition between inner and outer, which must be conceded if one concedes to anything individual in nature overall" (Schelling 1799, p. 84).[11] While it might at first appear that Schelling could just as easily replace the example of opium with food, sleep—nearly any activity—Schelling elected to use the example of opium

10. "Daß das Opium erregend wirkt, ist erklärt aus seiner chemischen, oder, was dasselbe ist, seiner elektrischen Beschaffenheit (darum wirkt es auch im Galvanismus) - aber seine mittelbare, d.h. durch die Thätigkeit des Organismus selbst vermittelte Wirkung ist narkotisch, und diese Wirkung ist freilich chemisch unerklärt: denn sie ist indirekt. So zeigt sich im Ganzen, daß eben dieselben Materien, welche die heftigste Erregbarkeit verursachen (was aus ihrer chemischen und elektrischen Beschaffenheit erklärt werden muß), indirekt die Erregbarkeit erschöpfen (was nun freilich nicht mehr aus ihrer chemischen Beschaffenheit erklärbar ist). Es ist kein Wunder, daß es mit den chemischen Erklärungen nicht fort will. Die letzte Wirkung der äußeren Ursachen auf den Organismus kann nicht mehr chemisch erklärt warden."

11. [...] "das ganze Geheimnis beruht auf jenem Gegensatz zwischen Innerem und Aeußerem, den man zugeben muß, wenn man in der Natur überhaupt etwas Individuelles zugibt."

because he, like Brown, understood it as being among those "materials which cause the most violent excitability" (Schelling 1799, p. 83).[12] Opium's divergent effects are taken up in describing the ways in which the forces of life, among them galvanism and animal magnetism, participate with, and even unfold from, the Röschlaubian principle of excitability, as the first principle of the organism.[13] Even Lorenz Oken, for whom "galvanism is the principle of life [and] there is no other life force than galvanic polarity," "excitability is the most general phenomenon of organic matter, and it belongs to plants and animals" (Oken 1810, pp. 10, 134).[14,15] As for Schelling, Oken understood narcotics to have profound effects on account of their role as stimulants of excitability, and subsequently the galvanic process (Oken 1843).

The success of the vital substance concept among German Romantic thinkers can at least in part be accounted for by the relationship between intoxication and the experience of embodiment. John Brown claimed to have based his medical system on his own experiences taking opium, while the crux of Sertürner's identification of morphine as opium's somniferic principle relied on self-experimentation (Brown 1788; Sertürner 1817). In each case, intoxication imparted some form of knowledge by viscerally interceding in one's lived experience of being in a body, which naturally appealed to the Romantic's intuitive philosophical conceptions, much like galvanism and mesmerism. While the last significant interest in mesmerism waned with the decline of German Romanticism, galvanism and the vital substance concept shared a different fate.

2. Neo-Mechanism in Revolt

Attributions of vitalistic properties to a wide array of intoxicating substances could still be found into the 1840s, notably in Johannes Müller's famous *Handbuch der Physiologie des Menschens*. Even as he disparaged the ideas of the Brunonians, Müller proposed that experimental evidence demonstrated that opium and alcohol stimulated nervous tissue at low doses (Müller 1834). At higher doses, Müller found that opium and alcohol altered, and thereby destroyed, nervous tissue, seemingly through a process of over-excitation—an idea which seemingly stemmed directly from the Okenian suggestion that narcotic poisoning functioned through

12. [...] "Materien, welche die heftigste Erregbarkeit verursachen."

13. The infamous case of Auguste Böhme further exemplifies the extent of Schelling's personal belief in Brunonianism on not only a theoretical, but on a practical level.

14. "[d]er Galvanismus ist das Princip des Lebens [and] es gibt keine andre Lebenskraft, als die galvanische Polarität."

15. [...] "die Erregbarkeit ist das allgemeinste Phänomen der organischen Masse, und kommt Pflanzen und Tieren zu."

over-polarization of the nervous system's galvanic polarity (Oken 1810, 1843). Müller himself was a vitalist, and his reception of the vital substance concept reflected both his belief in the physiological fact of vitalism and his aspirations of debriding the science of physiology of speculative conflations (Müller 1834). With a great debt to Alexander and Wilhelm Humboldt, Müller succeeded at turning the University of Berlin into the center of a research program focused on systematizing physiology, reforming physiology into a rigorous and experimentally focused science (Finger et al. 2013; Fullinwider 1991; Rothschuh 1973; Zimmer 2006). Müller's students, meanwhile, were in revolt. In the period from 1842 to 1847, Hermann Helmholtz, Ernst Brücke, Carl Ludwig, and Emil du Bois-Reymond each committed themselves wholly to the eradication of the theory of vitalism and a conclusive realization of physio-chemical processes as the foundation of all life, signing an oath, legend would have it, in their own blood (Cahan 1993; Fullinwider 1991; Greenwood 2015).[16] They were at the forefront of a neo-mechanist revolution. This meant wresting the sciences of the body from everything to do with vitalism, especially the vital substance concept.

To this end, du Bois-Reymond quickly laid siege to the influence of Brunonian vital stimulants in the experiments of Johann Ritter, Matteucci, and Giovanni Aldini (Du Bois-Reymond 1848, p. 98).[17] Primarily interested with electrophysiology, it is to be expected that du Bois-Reymond's *Untersuchung über thierische Elekticität* would address earlier claims made by galvanists about the nature of animal electricity. Yet, the number of references to Ritter greatly exceed those of nearly any researcher, with the notable exceptions of Volta and Matteucci (Du Bois-Reymond 1848). While admiring Ritter's tenacity, du Bois-Reymond freely opined about Ritter's erroneous attempts to understand electrophysical phenomena "according to the murky Brunonian categories of depression and excitation," seeing them as "modifications of the no less murky principle of excitability [or

16. There is a degree of debate concerning the veracity of the legend that they made a literal blood oath. Greenwood suggests that only the initial, 1842 pledge consisting of du Bois-Reymond, Ludwig, and Brücke was sealed in blood. In any case, the legend of an anti-vitalist blood oath effectively reflects the depths of their conviction, even if the blood oath itself is a fiction.

17. Du Bois-Reymond's refutations of Ritter are an interesting case. As a *Naturphilosoph*, Ritter's theoretical position was that galvanic and electrical currents fundamentally emerge from the same underlying principle. All of nature is an unfolding of an original unity, and Ritter even questioned whether heterogeneity (polarity) alone, in any context, was sufficient to develop a charge. Nevertheless, Ritter's experimental methods were not only Romantic, but influenced by Brunonian ideas, and so they had little place in the new science.

irritability]" (Du Bois-Reymond 1848, p. 367).[18] Concerning Aldini's findings that the introduction of a Brownian stimulant, such as an opium-alcohol solution, into the layers of the frog pile increased excitation, du Bois-Reymond disregarded them as deserving of little attention (Du Bois-Reymond 1848, p. 98). Skepticism concerning the role of vital stimulants even featured in du Bois-Reymond's raucous critiques of Carlo Matteucci's research on the galvanic frog pile, contradicting Matteucci's findings that there was a measurable difference in excitation when the galvanic pile employed opium-poisoned frogs (Du Bois-Reymond 1849, p. 171).

In each case, du Bois-Reymond made a concerted effort to undermine the validity of any remaining vestiges of Brunonian thinking. Even when Brunonian ideas is seemingly absent, nothing more than the mere suggestion of involving intoxicants in the experimental process, du Bois-Reymond nevertheless appears to have been committed to barring such impulses from the new science of physiology. It is as if the use of intoxicants in research, vital substances, and Brunonianism had become so inextricably linked that to permit the influence of anyone would be contrary to their mission of divesting physiology of vitalism. This perspective was indirectly supported by du Bois-Reymond, Helmholtz, and Brücke shared understanding that—unlike the speculative sciences of the Romantics, rich in metaphor and symbolic inference—physiology should henceforth be limited to the experimental study of the physio-chemical nature of life (Fullinwider 1991). Not only were vital substances conceptually excluded from their physio-chemical science, the experiential empiricism that initially gave rise to Brunonian theory was excluded on the basis of shifting criteria of epistemic validity.[19] Ironically, it had been precisely the non-scientific nature of late eighteenth-century medicine that had made possible the Brunonian system, even as Brown himself sought to imbue scientific systematicity upon the art of medicine. Now, developing notions of scientificity had all but eradicated the last vestiges of the Brunonian legacy in the life sciences.

Unsurprisingly, many coming from this new generation of physiologists, for the most part students of Helmholtz, Du Bois-Reymond, and Brücke, did not seem particularly preoccupied with studying the effects

18. "nach den dunklen Brown'schen Kategorieen von Depression und Exaltation vor sich gehende Modificationen der nicht minder dunklen Qualität Irritabilität."

19. Ironically, it had been precisely the non-scientific nature of late eighteenth-century medicine that had made possible the Brunonian system, even as Brown himself sought to imbue scientific systematicity upon the art of medicine.

of intoxicants. The case could be made that this was because studying states of intoxication were secondary to more fundamental physiological questions, such as the speed of an action potential, or the nature of nerve conduction. When substances of intoxicating are the subject of inquiry it is primarily relegated to the effect on a certain bodily function. It would appear that the emerging physio-chemical encounter with the body entailed a forgetting of the *experience* of the body. That is, the experience of *embodiment*, a notion so crucial to vitalistic thinking, and the intoxicated encounters that characterized the early nineteenth century. To this point, it is worth asking how the modern biological subject could emerge out of a neo-mechanistic conception of the body which did not also include the psychical experience of embodiment? The answer is simply that it did not.

3. Cortical Maps of an Interior World

By almost any measure, the neo-mechanist research program was incredibly productive, both at advancing novel, experimental observations about the body, and at embedding itself in a social and institutional milieu. Du Bois-Reymond's public disputes with Matteucci and other galvanists successfully vanquished much of the galvanic thinking carried forward from the nineteenth century, work almost immediately followed by Helmholtz's successful measurement of the speed of an action potential as it moved along the sciatic nerve (Finkelstein 2013; Glynn 2013; Helmholtz 1850). Yet, for all their swiftly gained achievements, the nature of thinking, of feeling—of the mind—remained something presumed, rather than something empirically demonstrated. Extending the neo-mechanistic model into the mind, Theodor Meynert, Brücke's student, developed his concept of cytoarchitecture into a full-fledged system intent on establishing a correlation between neurophysiological features and mental states, to map an interior world.

In the 1870's, Meynert was briefly held by some to be "the greatest brain-anatomist of his time," both for his prediction of cortical localization, as well as his pioneering efforts to develop a unified science of the mind grounded in brain science (Dalzell 2011, p. 68). But he was ultimately derided as something of a quack by the mid-1880's (Hakosalo 2006).[20] A similar fate would align with Meynert's enthusiastic student

20. The high point of Meynert's career is arguably the period from 1870–1876 following Hitzig and Fritsch's 1870 identification of the motor cortex in a dog, which was understood to be an experimental demonstration of Meynert's 1867 proposal that the theory of cortical inexcitability was incorrect (Fritsch and Hitzig 1870). Hitzig and Fritsch remarked that Meynert was perhaps the only person who, on an anatomical basis, predicted their experimental findings (Fritsch and Hitzig 1870, p. 307).

and closest ally, Carl Wernicke, whose own efforts to understand the mind physio-chemically were eventually perceived as equally dubious, particularly by a young Freud, despite Wernicke's important work on aphasia (Freud 1891; Marx 1970). The deterioration of Meynert's authority, and, by association, Wernicke's, from its highest point in the early 1870's was at least partially a product of methodological changes implemented by fellow physiologically-minded psychiatrists. Hakosalo makes a strong case that Meynert's disinterest in adapting his method of cross-sectioning the brain to Bernhard Gudden's 1875 method of hardening brain tissue, such that it could be sliced with a microtome, quickly left him at odds with the neurophysiological community (Hakosalo 2006). These latent tensions came to a head in a January 1878 meeting of the Medico-Psychological Society of Berlin, where Emmanuel Mendel gave a presentation concerning "whether the auditory pathway was related to the superior cerebellar peduncle or not" (Hakosalo 2006, p. 188). Wernicke was in attendance. Using Gudden's cross-sectioning method, Mendel demonstrated that the two structures were related by way of the dentate nucleus, a contradiction of Meynert's own findings (Hakosalo 2006). Wernicke spoke up, attempting to undermine the validity of this new method, to little effect.

With this in mind, it is clear that Meynert and Wernicke's haste to equate mental and neural states was not singularly at fault in their decline. Other brain psychiatrists, among them Gudden, Mendel, and Flechsig, were considerably more hesitant to make sweeping conceptual claims about the ultimate nature of mental life, especially in its most complex expressions. Meynert continued on in his work, publishing the ambitious *Ueber die Gefühle* in 1882. Yet, by this stage, Meynert's reputation, and the research program it represented, had fallen sharply from the stature it once commanded. "The psychiatric concepts of Meynert, even of some of his anatomy, were subsequently rejected by both the German and French schools of psychiatry," and, by the mid-1880's, Meynert faced broad criticisms that "his functional claims lacked factual support" (Triarhou 2021, p. 55). Prior to his death in 1891, "malicious tongues claimed that Meynert's only connection with psychiatry was that he had gone through delirium tremens" (Shorter 1997, p. 97).[21] In this sense, any meaningful

21. This is not to suggest Meynert's work was without merit. Triarhou points out that Meynert primarily expanded on earlier anatomical findings using his histological expertise, and Seitelberger credits Meynert with the pioneering development of a unified brain-science (Seitelberger 1997; Triarhou 2021). Ultimately, the life sciences have aligned themselves with Meynert's general vision of an interdisciplinary science of the brain, which informs psychiatric practice.

endeavor at a totalizing, physiologically reductive conception of the mind had been decisively routed, if only for a time.[22]

However, the development of the neo-mechanical research program out of the Berlin physiological school was from singularly representative of the models of mental life available in mid- to late-nineteenth-century Germany. In 1839, Gustav Fechner suffered a terrible accident while studying afterimages. Temporarily blinded, Fechner stepped down from his position as professor of physics and later sought to develop a method for systematically studying mental phenomena (Boring 1950; Heidelberger 2004). Of especial importance for Fechner was that psychic phenomena be measurable, something made possible with the advent of what he termed Weber's law: Ernst Weber's and Fechner's observation that the intensity of the perceived stimulus (S) of a sensation is the logarithm of the physical input (P) multiplied by a constant (K), or S = k log P (Fechner [1860] 1888, p. 17; Fancher and Rutherford 2016). Unlike Weber, who understood physiology in neo-mechanical terms, Fechner upheld the existence of a parallelistic duality of body and mind—the physical and the psycho-spiritual (psychical). Fechner's colleague, Wilhelm Wundt, took this a step further and in 1879 founded the first laboratory dedicated to the experimental encounter with psychological phenomena (Domanski 2004).[23] Although Wundt's foundational *Grundzüge de physiologischen Psychologie* dedicates a considerable portion of the text to topics such as the physiological mechanics of nervous function, Wundt argued that psychology merited recognition as a distinct scientific discipline because psychical phenomena fell outside of the

22. This is not to say that Gudden, Flechsig, etc. did not assume that mental states could be reduced to mental states, but rather that this functioned as an antecedent condition, which guided research, while Meynert had actually aspired to realize the idea, and reconceive of psychiatry, thereby.

23. There is considerable scholarly debate about the origins of Wundt's own parallelistic conception of the physical and the psychical. Fahrenberg and Klempe propose the Leibniz was an important influence on Wundt (Fahrenberg 2016; Klempe 2021) Significant influence on Wundt's ideas have even been attributed to John Stuart Mill (Boring 1950; Bistricky 2013). Though, as Araujo points out, the majority of Wundt's references to Mill's *Logic* are critical, and Wundt's own attributions of influence to Leibniz are inconsistent (Araujo 2016, p. 65). I propose that Fechner's direct influence can be seen in the incremental development of Wundt's *Beiträge zur Theorie der Sinneswahrnehmung*. In the portions written prior to 1860, there is little evidence, if any, to suggest that Wundt upheld a parallelistic understanding of the mind. Yet from 1860 onward, Wundt's *Beiträge* not only begin to make reference to Fechner, but the 1862 foreword states "dass [Fechner's law] in der That nicht ein physisches Gesetz ist," meaning "dass dasselbe Gesetz auch im Gebiet der höheren psychischen Thätigkeiten seine Gültigkeit behält" ["that [Fechner's law] is in fact not a physical law," meaning "that the same law retains its validity also in the field of higher psychic activities."] (Wundt 1862, p. xxx).

purview of physiology (Wundt 1874). Wundt further sought to overcome the failed neo-mechanical correlation between mental states and brain states in asserting a doctrine of psychological parallelism which denied the possibility of identification of the mind with cortical processes.[24] The psychical, not merely the psycho-physical, could be experimentally encountered, and, eventually, understood.

Simultaneously, Wundt maintained that the conscious process should not be understood as metaphysical or spiritual, as Fechner had, but rather as a psychical principle, in every sense emergent of a body shaped by physio-chemical processes (Engstrom 2015; Meischner-Metge 2010; Wundt 1874). Thus, if the "Berlin school" is to be understood as the great center of a pioneering conception of the subject grounded almost exclusively in "the body," the "Leipzig school" might rightly be considered the locus of an encounter with subjectivity concerned fundamentally with "embodiment," the study of the nature of conscious mental experience as mental experience. Wundtian psychology, after all, can be described as nothing less than the scientific study of the human experience of embodiment, denoting the summation of the dynamic, perceptional interaction with the lifeworld.

This raises an important point with respect to the modern conception of biologism. In the context of the nineteenth century, it was clear to those attempting to apply principles of neurophysiology, especially cortical localization, to mental states that a neo-mechanist model needed to be able to account for mental and emotional phenomena. As just discussed, it was the difficulty at doing so that created a space for Wundtian psychology. The result was, in a sense, a recapitulation of Fechnerian, or Leibnizian, mind-body dualism. This was a problem. Biologism could only mean uniting the entirety of self and world, embodiment and the body, within a dynamic material principle.

4. Intoxicated Psychology

This finally circles back to Kraepelin's 1877 late-night experience with morphine. Four years later (in 1881), Kraepelin wrote to Wundt to propose a topic for his post-doctoral project. Kraepelin wanted to research the effects of *Nervina*, like morphine, cocaine, amyl nitrate, tea, alcohol, and hashish, on reaction time (Kraepelin 1881). The premise was that, in studying the effects of different intoxicants on the mind, the rudimentary structures of the human psyche, and—with it—the ultimate nature of

24. Wundt had initially attempted to establish a career in physiology, studying under du Bois-Reymond, and working as Helmholtz's assistant in Heidelberg.

mental illness, could be brought to light (Kraepelin 1883a, 1883b). The proposed subject matter was timely. The German patent medicine had bloomed over the preceding decade, unfettered in 1871 by changes in the once-restrictive law concerning the manufacture of medicines (Woycke 1992, p. 44). One brand, F. A. Richter, earned in excess of five million marks annually by the 1880's (Woycke 1992, p. 44). Not only were substances of intoxication now more available than ever before, but innovations such as the development of Alexander Wood's syringe in 1853 and Oscar Liebreich's discovery of the psychoactive qualities of Liebig's chloral hydrate meant intoxication had begun to take on radical new forms (Brunton 2000; Snelders et al. 2006).[25]

Wundt approved of the project, and even encouraged Kraepelin to expand its scope to study their effects on a host of other mental phenomena. Though Kraepelin's work in Wundt's lab was cut short, Kraepelin's interest in the experimental investigation into the effects of various intoxicants and the mind became a project of personal importance, taking it with him wherever he went, including Munich, Dorpat, and Heidelberg (Steinberg and Müller 2005; Steinberg and Angermeyer 2001; Kraepelin 1883a, 1892).[26] In fact, Kraepelin and Wundt's exchange marked the christening of what is arguably *the* foundational concept of Kraepelin's project of experimental psycho-pathology: that intoxication was model psychosis. Rendered programmatic by his 1895 "Der psychologische Versuch in der Psychiatrie," Kraepelin proposed that the study of exogenous psychoses could shed light on the nature of endogenous psychoses, providing an experimental basis for psychiatry (Hildebrandt 1993; Kraepelin 1882, 1895; Müller-Sedgwick et al. 2006). Kraepelin's aspirations concerning the development of a new way forward in psychiatry, one supported by experimental psychology—rather than speculative nosologies or empty

25. Justus Liebig was the first to manufacture a synthetic intoxicant (chloral) in 1832, but was unaware of its effects (Liebig 1832).

26. Steinberg and Himmerich (2013) outline the complex circumstances under which Kraepelin completed his Habilitation, while the course of Kraepelin's early academic career can be found in Kraepelin's memoirs (1983) and Steinberg and Angermeyer (2001). Kraepelin lost his job in Paul Flechsig's psychiatric clinic, a financial loss that forced Kraepelin to propose that his Habilitation be awarded partially on the basis of previously completed work, as he required the rank of *Privatdozent* in order to charge fees to his students. Shortly thereafter, Kraepelin worked at a psychiatric clinic in Munich in the fall of 1883 and Leubus in 1884, before being able to return to academic life with a professorship in Dorpat in 1886, and then Heidelberg in 1890. Kraepelin's built a psychology laboratory in Dorpat, where he led and conducted research with intoxicants, and his experiments were continued in Heidelberg.

anatomical conflations—also formed the foundation of his extremely influential textbook, *Psychiatrie* (Heckers and Kendler 2020).[27]

Within the next 12 years, Kraepelin would conduct hundreds of experiments on the different effects of a wide array of intoxicants on different kinds of reaction time, and psychological processes. Kraepelin's 1883 publication focused on how various intoxicants, particularly amyl nitrate, chloroform, ether, and alcohol, affected various forms of reaction time, then Wundt's premier psychological research program (Kraepelin 1883a; Kraepelin 1883b; Danziger 1980). These early studies would blossom into multiple further sub-projects. Later experiments included, for example, measurements of the speed and accuracy with which a subject read an unfamiliar text aloud or their ability to memorize 12-digit series of numbers, whilst under the influence of various drugs (Kraepelin 1892). Other trials saw subjects, in many cases no other than Kraepelin himself, consume alcohol, morphine, or amyl nitrate before reviewing a battery of linguistic or conceptual associations, under the researcher's watchful eye (Kraepelin 1892). Throughout, Kraepelin went to great, often tiring, lengths to control for variable dosing, a major problem for the inhalant studies; the influence of practice; and impact of secondary bodily effects, such as the feeling of a full stomach after consuming alcohol (Kraepelin 1883a; Kraepelin 1883b; Kraepelin 1892).[28]

But this is far from the true extent of the legacy of Kraepelin's work on substances of intoxication. For, it is in the context of Kraepelin's experiments that substances of intoxication are marshalled as testifying witnesses concerning the fundamental nature of the relationship between the body and embodiment. Where Wundtian psychology had severed the psychical from the physical, the phenomenon of intoxication was the physicality of the body made real in the psychical. Intoxicants were a material substance that one can perceive as directly interceding in our experiences of embodiment. If pharmacologically induced disordering of the psychological process could mirror the effects of psychiatric illnesses, they could, in effect, serve as a bridge between the scientific psychological encounter with the mind and the physiological conception of the body.

27. The first edition of Kraepelin's textbook, published in 1883, was titled *Compendium der Psychiatrie.* Its name was changed to *Psychiatrie: Ein kurzes Lehrbuch für Studirende und Aerzte* with the second edition, published in 1887.

28. The majority of the Kraepelin's psychological research with intoxicants conducted between 1883–1892 is contained within his 1892 publication. To see an example of how his methodology developed while in Dorpat, see Heinrich Dehio's publication (Dehio 1887) while a student of Kraepelin's.

However, the context of this development is important. Kraepelin had not been the first to introduce intoxicants to psychological tests, earlier experiments having been run with morphine, wine, and tea by Sigmund Exner in 1873 and then by Dietl and Vintschgau in 1877 (Exner 1873; Dietl and Vintschgau 1877). But neither Exner nor Dietl and Vintschgau understood reaction time to be a psychological phenomenon. Rather, they framed "Reactionzeit" as a physiological concept, an outward expression of Helmholtz's earlier work on the propagation speed of an action potential across a nerve fiber (Exner 1873).[29] Further still, though Exner was the first to apply the measurement of reaction time to subjects in a state of intoxication, substances of intoxication were only introduced as modifiers of the subject's state of fatigue, which Exner recognized had a consistent effect on reaction time. Dietl and Vintschgau then sought to expand on Exner's limited trials with intoxicants, in part because Exner's experiments with intoxicants were all found to be inconclusive (Exner 1873; Dietl and Vintschgau 1877). If Kraepelin had studied the physiological effects of different intoxicants as Exner, Dietl, and Vintschgau had in 1873 and 1877, such work would not have had the same effect (Exner 1873; Dietl and Vintschgau 1877). It is only in studying the effects of intoxicants on the mind, on the psychical process, that intoxication could be conceptualized as thinking with the body. It was on the testimony of intoxicating substances that mind and flesh, embodiment and the body, could be sublated within a unified physiological doctrine, without subjecting mental states to the reductionism of neural states. This was the beginning of a conception of the body which was not mechanical but rather dynamically biological.

5. Conclusion

Scholarship has understandably focused on Kraepelin's legacy as a nosologist, owing to his noted impact on the development of modern psychiatric classification, especially concerning endogenous psychoses. Generally, this is at the loss of recognizing the impact of Kraepelin's participation in Wundtian psychology, and especially his work with substances of intoxication. Hoff makes strong effort to untangle the relationship between Kraepelin's significant nosological work and his early interest in experimental psychology, but ultimately marks a distinction between

29. Exner coined the term "reaction time" (*Reactionzeit*) in 1873, and identified the concept as the physiological basis of Friedrich Bessel's "personal equation" (persönliche Gleichung). Recognized by Bessel in the 1820's, Bessel's personal equation referred to a problem in astronomy where two observers of the same astral event consistently recorded different time measurements (Exner 1873).

Kraepelin's earlier psychological research and the role of Wundtian psychological concepts in Kraepelin's later classificatory projects (Hoff 1992, 1994, 2015). To this point, Hoff suggests that there is consistency between Kraepelin's earlier psychological work and later nosology at the level of psychological categories, with Kraepelin smoothing out some of the ambiguities in Wundt's model (Hoff 2015). A less generous position is Healy's perspective that Kraepelin's initial emphasis on psychology persisted in his later work in the form of an interest in "brain mechanisms" and "disease processes" (Healy 2009). Even German interest in Kraepelinian psychiatry, Healy suggests, may have relied on Karl Wernicke's premature death in 1905 (Healy 2009, pp. 23–4). Heckers and Kendler similarly identify only the first phase of Kraepelin's nosology (the first four editions of his textbook) with an effort to work through how Wundtian psychology might be integrated into existing diagnostic, aetiological, and nosological criteria, specifically through the textbooks of Shüle and v. Krafft-Ebing (Heckers and Kendler 2020). To varying degrees, each of these analyses of Kraepelin's legacy diminish the influence of his experimental psychological research in emphasizing Kraepelin's overt significance on the modern world as a nosologist.

Steinberg, alongside his various collaborators, has, more than anyone else, discussed the impact of Kraepelin's psychometric research with intoxicants. While acknowledging the novelty of Kraepelin's project and his concept of intoxication as a model psychosis, Steinberg and Müller nevertheless suggest that Kraepelin's pharmapsychological research program was a failure, as interest in furthering this type of research would not take hold for several decades (Steinberg and Müller 2005). But such an assessment relies on a decidedly narrow definition of the scope and duration of Kraepelin's research involving intoxicants. Steinberg and Müller identify Kraepelin's research with intoxicants for a 10-year period from his beginnings in Wundt's lab in 1882 to Kraepelin's publication of the first book on pharmapsychology in 1892 (Steinberg and Müller 2005; Kraepelin 1892). Yet, in 1899, Kraepelin published "Neuere Untersuchungen über die psychischen Wirkungen des Alkohols," and "Der Alkoholismus in München" in 1906 (Kraepelin 1899, 1906). In 1902, Kraepelin and Oseretzkowsky published the results of their experimental ergographic studies on the effects of alcohol, coffee, and tea, which directly influenced Kraepelin's development of a "work curve" for psycho-physical labor (Kraepelin and Oseretzkowsky 1901; Brain 2002; Kraepelin 1903). This, too, was preceded by Kraepelin and August Hoch's 1896 "Ueber die Wirkung der Theebestandtheile auf körperliche und geistige Arbeit" (Kraepelin and Hoch 1896). Hoch went on to teach at John Hopkins, where David Macht would introduce the term "pharmapsychology" to

English and even conduct his own reaction time trials involving opiate alkaloids (Kraepelin and Hoch 1896; Campbell 2007; Macht and Isaacs 1917). Here, psychological research on intoxicants directly shaped Kraepelin's understanding of the emerging neuroses of factory life. Without even taking into account his work on alcoholism through the 1890's and into the 1920's, it is clear that psychological experimentation with intoxicants was deeply formative of Kraepelin's work into the twentieth century, with impacts reaching toward the end of his career.

For now, this has been a brief effort to outline some of the major developments underlying the emergence of the biological subject in nineteenth-century German science. Emphasis rests on how Kraepelin's psychological experiments with intoxicants overcame conceptual ambiguities in the Wundtian psychology's understanding of higher-level psychological processes, contextualizing them through a physical, intoxicating referent. Such work was at the very forefront of the emergence of the biological subject, unifying the body with the dynamic, lived experience of the psychical in an experimental context. Where the vital substance concept had been all but erased by the rise of neo-mechanism, the perceptional modality of intoxication, that had given rise to the vital substance concept, endured. Intoxicated ways of knowing had been elemental to the development of a novel science of embodiment, providing a physical referent for psychical phenomena when Wundt's lab was still in its infancy. The impact of this distinct way of knowing can be seen above all else in the developing scientific understanding of the lifeworld of conscious perception, of the experience of embodiment (the world of intoxication). When efforts at mechanistic and physiological accounts of mental phenomena fell short of expectations in the 1870's–1880's, it was the science of embodiment that ultimately provided the most persuasive critique. The by-product was a suggestion that the understanding of embodiment and the study of the body are part of a shared conceptual framework: a science of higher order mental life and a science of the body. The study of living embodiment was irreducible to physio-chemical processes in light of the mind's dynamic encounter with the world, and yet was nevertheless conceptually comprised of the *Stoff* of physio-chemical processes. Institutionally, this twofold conception of biologism, of being a biological subject, is reflected in the structure of the modern psychology and neuroscience departments, where, even as psychology and neuroscience share one roof, the science of experimental psychology remains irreducible to neuro-chemical anatomy. The new human being that emerged was vital, without being vitalistic, is purely physical, without being materialistic. The influence of this shift not only endures to this day it had an almost immediate effect on the philosophies and social theories of the late nineteenth century, from Nietzsche's

philosophy of the body to Weber's conception of the subject. It may be the case that the emergence of the biological subject stands almost entirely on the legacy of our varied encounters with the intoxicated body.

References

Araujo, Saulo. 2016. *Wundt and the Philosophical Foundations of Psychology: A Reappraisal*. Cham, Switzerland: Springer International. https://doi.org/10.1007/978-3-319-26636-7

Bergman, Norman. 1991. "Humphry Davy's Contribution to the Introduction of Anesthesia: A New Perspective." *Perspectives in Biology and Medicine* 34(4): 534–541. https://doi.org/10.1353/pbm.1991.0020, PubMed: 1923695

Bistricky, S. L. 2013. "Mill and Mental Phenomena: Critical Contributions to a Science of Cognition." *Behavioral Sciences* 3(2): 217–231. https://doi.org/10.3390/bs3020217, PubMed: 25379235

Boring, Edwin. 1950. *A History of Experimental Psychology*. 2nd ed. New York: Appleton-Century-Crofts.

Brain, Robert. 2002. "The Ontology of the Questionnaire: Max Weber on Measurement and Mass Investigation." *Studies in History and Philosophy of Science* 32: 647–684. https://doi.org/10.1016/S0039-3681(01)00026-7, PubMed: 11774888

Brown, John. 1788. *The Elements of Medicine Or, A Translation of the Elementa Medicinae Brunonis*. London: J. Johnson. https://www.google.com/books/edition/The_Elements_of_Medicine_Or_A_Translatio/lMkF0HdEENYC?hl=en&gbpv=1&pg=PA1&printsec=frontcover

Brunton, D. 2000. "A Question of Priority: Alexander Wood, Charles Hunter and the Hypodermic Method." *Proceedings of the Royal College of Physicians of Edinburgh* 30: 349–351. https://doi.org/10.1177/147827150003000414

Brühl-Cramer, Cramer. 1819. *Ueber die Trunksucht und eine rationelle Heilmethode derselben*. Berlin.

Cahan, David. 1993. *Hermann von Helmholtz and the Foundations of Nineteenth-Century Science*. Berkeley: University of California Press.

Campbell, N. D. 2007. "'The Man with the Syringe': Pain and Pleasure in the Experimental Situation." Pp. 83–112 in *Discovering Addiction: The Science and Politics of Substance Abuse Research*. Ann Arbor: University of Michigan Press.

Cooke, Michael. 1974. "De Quincey, Coleridge, and the Formal Uses of Intoxication." *Yale French Studies*, 50, Intoxication and Literature: 26–40. https://doi.org/10.2307/2929463

Dalzell, Tom. 2011. "What Freud learned in Theodor Meynert's Clinic". *The Letter: Irish Journal for Lacanian Psychoanalysis* 49: 65–72.

Danziger, Kurt. 1980. "Wundt's Theory of Behavior and Volition." Pp. 89–115 in *Wilhelm Wundt and the Making of a Scientific Psychology*. Edited by R. W. Rieber. Boston: Springer. https://doi.org/10.1007/978-1-4684-8340-6_3

de la Mettrie, J. 1748. *L'homme machine*. Leiden: De l'imp. D'Elie Luzac, fils.

Dehio, H. 1887. *Untersuchungen über den Einfluss des Coffeïns und Thees auf die Dauereinfacher psychischer Vorgänge*. Dorpat: Laakmann.

Dietl, M., and M. Vintschgau. 1877. "Das Verhalten der physiologischen Reactionszeit unter dem Einfluss von Morphium, Caffée, und Wein." *Archiv für die gesammte Physiologie des Menschen und der Tiere* 16: 316–408. https://doi.org/10.1007/BF01647544

Domanski, Cezary. 2004. "A Biographical Note on Max Friedrich (1856–1887), Wundt's First Phd Student in Experimental Psychology." *Journal of the History of the Behavioral Sciences* 40(3): 311–317. https://doi.org/10.1002/jhbs.20022, PubMed: 15237420

du Bois-Reymond, Emil. 1848. *Untersuchungen über thierische Elektricität, Erster Band*. Berlin: Verlag von G. Reimer.

du Bois-Reymond, Emil. 1849. *Untersuchungen über thierische Elektricität, Zweiter Band*. Berlin: Verlag von G. Reimer.

Engstrom, Eric. 2015. "On Attitudes toward Philosophy and Psychology in German Psychiatry, 1867–1917." Pp. 149–164 in *Philosophical Issues in Psychiatry III: The Nature And Sources of Historical Change*. Edited by K. S. Kendler and J. Parnas. Oxford: Oxford University Press. https://doi.org/10.1093/med/9780198725978.003.0017

Exner, Sigmund. 1873. "Experimentelle Untersuchung der einfachsten psychischen Processe: Erste Abhandlung." *Archiv für die gesammte Physiologie des Menschen und der Thiere* 7: 601–688. https://doi.org/10.1007/BF01613351

Fahrenberg, Jochen. 2016. "Leibniz' Einfluss auf Wundts Psychologie und Philosophie." *Psychologische Rundschau* 67(4): 276. https://doi.org/10.1026/0033-3042/a000332

Fancher, Raymond, and Rutherford, Alexandra. 2016. "The Sensing and Perceiving Mind: From Kant Through the Gestalt Psychologists." In *Pioneers of Psychology*. New York: Norton and Company.

Fechner, Gustav. [1860] 1888. *Elemente der Psychophysik, Erster Theil*. 2nd ed. Leipzig: Druck und Verlag von Breitkopf und Härtel.

Finger, Stanley, Marco Piccolino, and Frank Stahnisch. 2013. "Alexander von Humboldt: Galvanism, Animal Electricity, and Self-Experimentation Part 2: The Electric Eel, Animal Electricity, and Later Years." *Journal of the History of the Neurosciences* 22(4): 327–352. https://doi.org/10.1080/0964704X.2012.732728, PubMed: 23581510

Finkelstein, Gabriel. 2013. *Emil du Bois-Reymond: Neuroscience, Self, and Society in Nineteenth-Century Germany*. Cambridge, Mass.: MIT Press. https://doi.org/10.7551/mitpress/9543.001.0001

Freud, Sigmund. 1891. *Zur Auffassung der Aphasien*. Leipzig und Wein: F. Deuticke.

Fritsch, Gustav, and Hitzig, Eduard. 1870. "Über die elektrische Erregbarkeit des Großhirns." *Archiv für Anatomie, Physiologie und Wissenschaftliche Medicin*: 300–332.

Fullinwider, S. 1991. "Darwin Faces Kant: A Study in Nineteenth-Century Physiology." *The British Journal for the History of Science* 24(1): 21–44. https://doi.org/10.1017/S0007087400028430

Gantet, Claire. 2021. "The Dissemination of Mesmerism in Germany (1784–1815): Some Patterns of the Circulation of Knowledge." *Centaurus* 63(4): 762–778. https://doi.org/10.1111/1600-0498.12396

Gao, Menglu. 2020. "'Founding Its Empire on Spells of Pleasure': Brunonian Excitability, the Invigorated English Opium-Eater, and De Quincey's 'China Question'." *Literature and Medicine* 38(1): 1–25. https://doi.org/10.1353/lm.2020.0001, PubMed: 33416593

Glynn, Ian. 2013. *Elegance in Science: The Beauty of Simplicity*. Oxford: Oxford University Press.

Golinski, Jan. 2011. "Humphry Davy: The Experimental Self." *Eighteenth-Century Studies* 45(1): 15–28. https://doi.org/10.1353/ecs.2011.0040

Greenwood, John. 2015. *A Conceptual History of Psychology*. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9781107414914

Hakosalo, Heini. 2006. "The Brain under the Knife: Serial Sectioning And The Development Of Late Nineteenth-Century Neuroanatomy." *Studies in History and Philosophy of Biological and Biomedical Sciences* 37(2): 172–202. https://doi.org/10.1016/j.shpsc.2006.03.010, PubMed: 16769555

Healy, David. 2009. *The Creation of Psychopharmacology*. London: Harvard University Press.

Heckers, Stephan, and Kenneth Kendler. 2020. "The Evolution of Kraepelin's Nosological Principles." *World Psychiatry: Official Journal of the World Psychiatric Association (WPA)* 19(3): 381–388. https://doi.org/10.1002/wps.20774, PubMed: 32931122

Heidelberger, Martin. 2004. *Nature from Within: Gustav Theodor Fechner and His Psychophysical Worldview*. Pittsburgh: University of Pittsburgh Press.

Helmholtz, Hermann von. 1850. "Vorläufiger Bericht über die Fortpflanzungs-Geschwindigkeit der Nervenreizung." *Archiv für Anatomie, Physiologie und wissenschaftliche Medicin*: 71–73.

Hildebrandt, Helmut. 1993. "Der psychologische Versuch in der Psychiatrie: Was wurde aus Kraepelins (1895) Programm?." *Psychologie und Geschichte* 5(1/2): 5–30.

Hoff, Paul. 1992. "Psychiatrie und Psychologie-Bemerkungen zum Hintergrund des Kraepelinschen Wissenschaftsverständnisses." Pp. 25–43 in *Pharmakopsychologie-Experimentelle und klinische Aspekte*. Edited by J. Oldigs-Kerber and J. P. Leonhard. Stuttgart: Fischer.

Hoff, Paul. 1994. *Emil Kraepelin und die Psychiatrie als klinische Wissenschaft. Ein Beitrag zum Selbsverständnis psychiatrischer Forschung* [Monographien aus dem Gesamtgebiet der Psychiatrie 73]. Berlin, Heidelberg, New York: Springer. https://doi.org/10.1007/978-3-642-85079-0

Hoff, Paul. 2015. "The Kraepelinian Tradition." *Dialogues in Clinical Neuroscience* 17(1): 31–41. https://doi.org/10.31887/DCNS.2015.17.1/phoff, PubMed: 25987861

Kielhorn, Friedrich-Wilhelm. 1996. "The History of Alcoholism: Brühl-Cramer's Concepts and Observations." *Addiction* 91(1): 121–128. https://doi.org/10.1046/j.1360-0443.1996.91112114.x, PubMed: 8822020

Klempe, Sven Hroar. 2021. "The Importance of Leibniz for Wundt." *Human Arenas* 4: 20–31. https://doi.org/10.1007/s42087-020-00169-9

Kraepelin, Emil. 1881. Brief an Wilhelm Wundt, München, 1. Aug. 1881. Wundtbriefwechsel, https://home.uni-leipzig.de/wundtbriefe/viewer.htm

Kraepelin, Emil. 1882. "Ueber psychische Zeitmessungen." *Schmidt's Jahrbücher der in- und ausländischen gesammten Medicin* Bd. 196, S. 205–213.

Kraepelin, Emil. 1883a. "Ueber die Einwirkung einiger medicamentöser Stoffe auf die Dauer einfacher psychicher Vorgänge, Erste Abteilung, Ueber die Einwirkung von Amylnitrit, Aethyläther und Chloroform." *Philosophische Studien* 1: 417–462.

Kraepelin, Emil. 1883b. "Ueber die Einwirkung einiger medicamentöser Stoffe auf die Dauer einfacher psychicher Vorgänge, Zweite Abteilung, Ueber die Einwirkung von Aethylalkohol." *Philosophische Studien* 1: 573–605.

Kraepelin, Emil. 1892. *Ueber die Beeinflussung einfacher psychischer Vorgänge durch einige Arzneimittel*. Jena: Gustav Fischer.

Kraepelin, Emil. 1895. "Der psychologische Versuch in der Psychiatrie." *Psychologische Arbeiten* 1: 1–91.

Kraepelin, Emil. 1899. "Neuere Untersuchungen über die psychischen Wirkungen des Alkohols." *Internationale Monatsschrift zur Bekämpfung der Trinksitten* Jg. 9: 321–332; *Münchener Medicinische Wochenschrift* Jg. 46: 1365–1369.

Kraepelin, Emil. 1903. *Ueber Geistige Arbeit. Zweite*. Jena: Gustav Fischer.
Kraepelin, Emil. 1906. "Der Alkoholismus in München." *Münchener Medizinische Wochenschrift* Jg. 53: 737–741.
Kraepelin, Emil. 1983. *Lebenserinnerungen*. Edited by H. Hippius, G. Peters, and D. Ploog. Berlin, Heidelberg: Springer. https://doi.org/10.1007/978-3-662-00847-8
Kraepelin, Emil, and August Hoch. 1896. "Ueber die Wirkung der Theebestandtheile auf körperliche und geistige Arbeit." Emil Kraepelin (Hg.): *Psychologische Arbeiten* 1: 378–488.
Kraepelin, Emil, and Alexis Oseretzkowsky. 1901. "Ueber die Beeinflussung der Muskelleistung durch verschiedene Arbeitsbedingungen." Emil Kraepelin (Hg.): *Psychologische Arbeiten* 3: 587–690.
Lewontin, Richard. 2003. *Biology as Ideology*. Toronto: Anansi.
Liebig, Justus. 1832. "Ueber die Verbindungen, welche durch Einwirkung des Chlors auf Alkohol, Aether, ölbildendes Gas und Essiggeist entstehen." *Annalen der Pharmacie* 1: 182–230. https://doi.org/10.1002/jlac.18320010203
Macht, David, and Schachne Isaacs. 1917. "Action of Some Opium Alkaloids on the Psychological Reaction Time." *Psychobiology* 1(1): 19–32. https://doi.org/10.1037/h0074577
Maehle, Andreas-Holger. 1999. *Drugs on Trial: Experimental Pharmacology and Therapeutic Innovation in the Eighteenth Century*. Amsterdam: Rodopi. https://doi.org/10.1163/9789004333291
Marx, Otto. 1970. "Nineteenth-Century Medical Psychology: Theoretical Problems in the Work of Griesinger, Meynert, and Wernicke." *Isis* 61(3): 355–370. https://doi.org/10.1086/350651, PubMed: 4928002
Meischner-Metge, Anneros. 2010. "Gustav Theodor Fechner: Life and Work in the Mirror of His Diary." *History of Psychology* 13(4): 411–423. https://doi.org/10.1037/a0021587, PubMed: 21688734
Montiel, Luis. 2009. "Une révolution manquée: Le magnétisme animal dans la médecine du romantisme allemand." *Revue d'histoire du XIXe Siècle* 38: 61–77. https://doi.org/10.4000/rh19.3870
Morrison, Robert. 1997. Opium-Eaters and Magazine Wars: De Quincey and Coleridge in 1821. *Victorian Periodicals Review* 30(1): 27–40.
Müller, Johannes. 1834. *Handbuch der Physiologie des Menschen*, Band I. Koblenz: Verlag von J. Hölscher. https://doi.org/10.5962/bhl.title.128395
Müller-Sedgwick, Ulrich, Paul Fletcher, and Holger Steinberg. 2006. "The Origin of Pharmacopsychology: Emil Kraepelin's Experiments in Leipzig, Dorpat and Heidelberg (1882–1892)." *Psychopharmacology* 184: 131–138. https://doi.org/10.1007/s00213-005-0239-5, PubMed: 16378216

Oken, Lorenz. 1810. *Lehrbuch der Naturphilosophie* (Dritter Teil, erstes and zweites Stück). Jena: Friedrich Frommann.

Oken, Lorenz. 1843. *Lehrbuch der Naturphilosophie*. Zurich: F. Schulthess. https://archive.org/details/bub_gb_cqE5AAAAcAAJ/page/n1/mode/2up

Partington, Jonathan. 1962. "Chemistry in Germany." Pp. 567–604 in *A History of Chemistry*. London: Palgrave. https://doi.org/10.1007/978-1-349-00309-9_12

Röschlaub, Andreas. 1798. *Untersuchungen über Pathogenie oder Einleitung in die medizinische Theorie*, Band I. Frankfurt: Andreä. https://www.google.com/books/edition/Untersuchungen_%C3%BCber_Pathogenie_oder_Ein/ma0_AAAAcAAJ?hl=en

Röschlaub, Andreas. 1799. Untitled ("An J. G. Fichte"). Pp. xi–xvi in *Magazin zur Vervollkommnung der theoretischen und praktischen Heilkunde*. 1st Ed., Band 2. Frankfurt: Andreä. https://www.digitale-sammlungen.de/en/view/bsb10086092?page=,1

Rothschuh, Karl. 1973. *History of Physiology*, trans. Guenter B. Risse. Huntington, NY: Robert E. Krieger.

Schelling, F. W. [1799] 1858. "Erster Entwurf eines Systems der Naturphilosophie." Pp. 1–269 in *Sämtliche Werke von F. W. Schelling 1799–1800*, Dritter Band. Stuttgart and Augsburg: Gottascher Verlag.

Schelling, F. W. 1799. "Einige Bemerkungen aus Gelegenheit einer Rezension Brown'scher Schriften in der A. L. Z.". Pp. 255–262 in *Magazin zur Vervollkommnung der theoretischen und praktischen Heilkunde*. 1st Ed., Band 2.

Seitelberger, Franz. 1997. "Theodor Meynert (1833–1892), Pioneer and Visionary of Brain Research." *Journal of the History of the Neurosciences* 6(3): 264–274. https://doi.org/10.1080/09647049709525713, PubMed: 11619863

Sertürner, Friedrich. 1805. "Säure im Opium." *Journal der Pharmacie* xiv: 33–57.

Sertürner, Friedrich. 1817. "Ueber das Morphium, eine neue salzfähige Grundlage, und die Mekonsäure, als Hauptbestandtheile des Opiums." *Annalen der Physik* 55(1): 56–92. https://doi.org/10.1002/andp.18170550104

Shorter, Edward. 1997. *A History of Psychiatry*. New York: John Wiley & Sons.

Snelders, Stephen, Charles Kaplan, and Toine Pieters. 2006. "On Cannabis, Chloral Hydrate, and Career Cycles of Psychotropic Drugs in Medicine." *Bulletin of the History of Medicine* 80(1): 95–114. https://doi.org/10.1353/bhm.2006.0041, PubMed: 16549883

Steinberg, Holger, and Müller, U. 2005. "Emil Kraepelin 1882/83 in Leipzig und seine frühen pharmakopsychologischen Arbeiten im Licht

der aktuellen Forschung." Pp. 121–154 in *200 Jahre Psychiatrie an der Universität Leipzig*. Edited by M. C. Angermeyer and H. Steinberg. Berlin, Heidelberg: Springer. https://doi.org/10.1007/3-540-28048-0_3

Steinberg, Holger, and Matthias Angermeyer. 2001. "Emil Kraepelin's Years at Dorpat as Professor of Psychiatry in Nineteenth-Century Russia." *History of Psychiatry* 12(47 Pt 3): 297–327. https://doi.org/10.1177/0957154X0101204703, PubMed: 11951915

Steinberg, Holger, and Hubertus Himmerich. 2013. "Emil Kraepelin's Habilitation and His Thesis: A Pioneer Work for Modern Systematic Reviews, Psychoimmunological Research and Categories Of Psychiatric Diseases." *The World Journal of Biological Psychiatry: The Official Journal of the World Federation of Societies of Biological Psychiatry* 14(4): 248–257. https://doi.org/10.3109/15622975.2011.623717, PubMed: 22206489

Triarhou, Lazoros. 2021. "Pre-Brodmann pioneers of Cortical Cytoarchitectonics I: Theodor Meynert, Vladimir Betz and William Bevan-Lewis." *Brain Structure and Function* 226: 49–67. https://doi.org/10.1007/s00429-020-02168-6, PubMed: 33165657

Tsouyopolous, Nelly. 1982. *Andreas Röschlaub und die romantische Medizin: die philosophischen Grundlagen der modernen Medizin*. Stuttgart: G. Fischer.

Tsouyopolous, Nelly. 1988. "The Influence of John Brown's Ideas in Germany." *Medical History*. Supplement 32: 63–74. https://doi.org/10.1017/S0025727300070800

Woycke, James. 1992. "Patent Medicines in Imperial Germany." *Canadian Bulletin of Medical History / Bulletin canadien d'histoire de la médecine* 9: 41–56. https://doi.org/10.3138/cbmh.9.1.41, PubMed: 11612844

Wundt, Wilhelm. 1862. *Beiträge zur Theorie der Sinneswahrnehmung*. Heidelberg: Winter'sche.

Wundt, Wilhelm. 1874. *Grundzüge de physiologischen Psychologie*. Leipzig: Engelmann.

Zimmer, Heinz-Gerd. 2006. "Profiles in Cardiology: Johannes Müller." *Clinical Cardiology* 29, 327–328. https://doi.org/10.1002/clc.4960290714, PubMed: 16881546