

Localization and Its Discontents

*A Genealogy of Psychoanalysis
and the Neuro Disciplines*

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Introduction

In early 2013, the European Commission announced the winners of its prestigious Future and Emerging Technologies competition. Of the two projects selected as European “flagships,” it was the Human Brain Project that gained most attention. It is designed to run for at least ten years and will receive funding of more than 1 billion euros. Coordinated by the neuroscientist Henry Markram, director of the Brain Mind Institute and the Center for Neuroscience and Technology at the Ecole Polytechnique at Lausanne, the project aims to simulate a human brain in a supercomputer, pushing forward developments in neuroscience, medicine, and computing. Markram is building upon his previous research combining Information and Computing Technology and neurobiology to integrate the knowledge and skills of scientists from different countries and different fields, thus creating a “CERN for the brain.”

Just three weeks later, in his State of the Union address, President Barack Obama announced his own billion-dollar investment. The BRAIN project (Brain Research through Advancing Innovative Neurotechnologies) hopes to harness new mapping techniques to examine the interaction of individual neurons. While the Europeans are tying their project to the recent developments in particle physics (not coincidentally, another Swiss success story), the Americans are working on creating a “second Human Genome Project.” The comparison speaks not only to the hope for economic return—Obama emphasized in his announcement that every dollar invested in the human genome project returned \$140 to the economy—but also to its focus on individual elements, in this case the activity of neurons. The project seeks to combine imaging technologies with single-cell recordings, mapping the activity of every one of the approximately 100 billion neurons in the human brain. For 2014 it was supported

with around \$100 million, with a similar annual budget projected over its expected lifetime of ten years.

These two announcements have confirmed neuroscience as “big science.”¹ The success of neuroscience is a product of new technologies that can examine, track, and model with ever greater precision the workings of the brain. But more broadly, we can attribute its success to the ways in which those technologies have helped confirm a materialist, more specifically a somaticist, viewpoint. Neuroimaging technologies such as fMRI (functional magnetic resonance imaging) and PET (positron emission tomography) couple state-of-the-art detection techniques with powerful computational systems to locate and analyze subtle physiological changes in the brain. When correlated with mental processes, they allow the production of colorful brain scans that strongly suggest the cerebral locations of thought, empathy, emotion, even religiosity. Such images take pride of place in numerous magazines and newspapers and constitute the public face of neuroscience today.

Not surprisingly, these claims have met with criticism, in particular the assumption that the location of physiological changes in the brain can be identified with the site of clearly defined mental functions. The neuroscientist William Uttal argued in his 2001 book *The New Phrenology: The Limits of Localizing Cognitive Processes in the Brain* that this assumption is a holdover from the phrenology of the eighteenth and nineteenth centuries.² Phrenologists like Franz Joseph Gall correlated the measurement of the skull with certain psychological functions “seated” in particular areas of the brain, a practice that now appears to us, in Uttal’s words, as “nonsense.”³ Insofar as modern neuroscience seems to be doing the same thing, it confronts the same criticism.⁴

While Uttal may be right about these localizing tendencies, especially as they have been nurtured by the successes of neuroimaging, it is important to recognize that today we are witnessing a shift in the neuroscientific landscape. In fact, if we look closely at the two projects I mentioned at the outset, which are representative of broader trends in the field, we can see that the attempt to localize higher functions has taken a backseat to a different endeavor. Both the American project and the European project aim to decode the brain’s “connectational architecture,” where the main lines on the maps do not divide areas cleanly from each other but rather form a network crossing boundaries and spanning the brain. The key word of this venture is not “center” but “circuit.” In the words of *Nature* correspondent Alison Abbott, the scientists want to work out how the “billions of neurons . . .

in the human brain organize themselves into working neural circuits that allow us to fall in love, go to war, solve mathematical theorems or write poetry.” What is more, they aim to understand how brain circuitry shifts as synapses, the points of connections between nerve cells, constantly change their form.⁵ Scientists are beginning to generate such a “network map,” a “comprehensive structural description of the network of elements and connections forming the human brain.”⁶ The goal is not to create an “exact replica of the connective anatomy down to the finest ramifications of neurites and individual synaptic boutons.” Rather, “like any good road map,” the “connectome” of the human brain should afford a “multiscale description of the topological and spatial layout of connective anatomy.”⁷ This shift in the goals of contemporary neuroscience has led its practitioners to declare that we have entered a new “connectomic era.”⁸

While for most neuroscientists the connective and localizing traditions coexist, that coexistence is an uneasy one. As the German neurobiologist Gerhard Roth has stated, no self-respecting neurobiologist today would seriously claim that a higher function, such as “syntactic-grammatical language,” was “‘located’ in Broca’s area.” Rather, “these brain centers have these qualities, amongst other things, because they are connected to certain other brain centers as well as with certain sensory inputs and motor outputs.”⁹ In the connectomic era, function is considered to be the product of highly complex nervous circuits both within and (crucially) crossing anatomical boundaries. When scientists trace the passage of a nervous signal across a brain circuit, it is very difficult to privilege any one part of the path and identify it as the “cerebral location” of a particular function. For this reason the simple identity between location and function, which neuroimaging promoted and Uttal criticized, is challenged by the new paradigm. Insofar as we can identify in it both localizationist and connectomic approaches, modern neuroscience remains caught between contradictory principles.

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This is not the first time that these principles have coexisted uneasily in the mind and brain sciences. In the 1860s and 1870s, neuropsychiatry, as practiced by figures such as Theodor Meynert in Vienna and Carl Wernicke in Breslau, combined a concern to locate mental faculties in particular centers of the brain with an essentially connectivist model of brain

function. In this book, I examine this earlier moment and think through the consequences of the shifting balance between the two principles at the practical, theoretical, and institutional levels.¹⁰

Like modern neuroscience, nineteenth-century localization participated in a general enthusiasm for somatic explanations. Developments such as the introduction of anesthesia and antiseptic techniques into surgery, and the increasing acceptance of the germ theory of disease, spurred a general optimism about the new “scientific medicine.”¹¹ In Vienna, where much of my story takes place, this drive to a somatic medicine was led by the pathological anatomist Carl von Rokitansky. Rokitansky, after the revolutions of 1848, turned his institute into the center, the hub, of the Vienna General Hospital, and his methods gained traction in a variety of fields.

In psychiatry, the terms of the new paradigm were set with Wilhelm Griesinger’s midcentury prescription: “Mental disease is brain disease.” Meynert and Wernicke were two of the most prominent figures to heed Griesinger’s call. They hoped to translate psychiatric conditions into the language of brain pathology and to identify the cerebral locations of psychological functions.¹² The neuropsychiatric project was able to draw on the support of a number of parallel developments at the time, not least the collaboration between Berlin electrotherapist Eduard Hitzig and anatomist Gustav Fritsch. In their experiments, Fritsch and Hitzig had stimulated parts of a dog’s cortex electrically, eliciting the movement of select body parts, which allowed them to map the motor areas of the animal’s brain.¹³

But though localization was dominant, during this period it was closely bound up with a connective principle: the reflex. A reflex is made up of the nervous connections between sense organs and muscles, which pass through the central nervous system (the spinal cord or the brain). Over the course of the nineteenth century, this sensory-motor system became the dominant principle for explaining nervous function. It also furnished a clinical practice. The reflex allowed practitioners to engage with the patient’s nervous system, and consequently the “reflex test” became the central element of the neurological examination.¹⁴

Reflex physiology proved useful for neuropsychiatrists like Meynert and Wernicke because it provided an authoritative somatic framework for explaining nervous function and thus underpinned the localization project.¹⁵ Moreover, by furnishing a model for the nervous connections between periphery and center, the reflex helped explain why certain parts

of the brain might control certain functions, initiate certain movements, receive sensory experience, or govern particular tasks like speech. In this understanding, the motor center for hand movement, for instance, was connected to the hand by the efferent arc of a reflex. The prominence of the reflex tradition led to one of the great innovations in localization during this period: the division of higher functions into sensory and motor components, each to be located in a different part of the brain.

But it is important to recognize that the connective principle not only supported but also undermined localization, much as in our connectomic era today. From the latter decades of the nineteenth century, as a result of shifting political and social considerations—Bismarck's social insurance, new patient concerns in fin-de-siècle Vienna, changing patient populations during the Great War—the examination and treatment of patients became increasingly central to neuropsychiatrists and neurologists. In this context, physicians like Wernicke prioritized the practical aspects of the reflex. One of the great advantages of the reflex as applied to higher functions was that it provided the tools to structure the clinical psychiatric examination. And the neat demarcations between functions suggested by the localization paradigm showed themselves to be increasingly inadequate for elucidating the unpredictable and confusing symptoms of psychiatric patients. For while reflex physiology as a *theory* supported the division of functions into sensory and motor elements, within reflex *practice* the sensory and motor parts could not be disconnected so easily. According to the localization model, a reflex arc passed through at least two centers: a sensory center at the end of the afferent (inward-conducting) arc, and a motor center at the end of the efferent (outward-conducting) reflex arc. But in the reflex test, a sensory stimulus was always correlated with a motor response, such that it was difficult to see either as independent of the other or to identify neatly compartmentalized sensory and motor centers. That is, the reflex as a *clinical* principle foregrounded its systemic, connective aspects, how different nervous elements functioned together, and this posed a considerable challenge to the atomizing tendencies of the localization project.

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There are, of course, marked differences between neuropsychiatry and early-twenty-first-century neuroscience. But the comparison is instructive

because it allows us to track how the criticism of localization through a connective principle has played out before, and thus provides valuable means for thinking through our present situation. For what is surprising about the earlier moment is that the prioritization of connectivity, far from heralding a new neuropsychiatric era, introduced considerable disciplinary instability into it. Most importantly, it provided the resources for the construction of two new and diverse fields: psychoanalysis and neurology.

That the histories of neurology and neuropsychiatry cannot be separated, at least in the German context, is simultaneously uncontroversial and understudied.¹⁶ Otfrid Foerster, one of the most prominent figures in German neurology in the interwar period, worked with Wernicke between 1900 and 1904, first as his *Volontärarzt* (unsalaried physician) and then as assistant at the psychiatric clinic and the neurological polyclinic. Foerster also undertook research in Wernicke's neuropathological laboratory, where he was in charge of producing the third volume of a photographic atlas of the brain, a costly and ambitious project funded by the prestigious *Königliche Akademie der Wissenschaften*.

Scholars are also aware that psychoanalysis can trace roots back to neuropsychiatry.¹⁷ Sigmund Freud joined Meynert's laboratory in 1883, at a time when he was also working as Meynert's *Sekundararzt* at the Vienna General Hospital. Even after Freud had moved on with his clinical rotations, he continued to conduct research in the lab for an additional two years. During this period he wrote a number of the articles submitted for his *Habilitation* in neuropathology.¹⁸

But despite the intensity of Freud's engagement with the neuropsychiatric tradition, the overwhelming tendency in the scholarly literature has been to consider this early work as part of his "pre-analytic" phase, with little importance for his later studies.¹⁹

In contrast, I argue that Freud's early participation in the debates over pathological anatomy and reflexes in the 1870s and beyond played a signal role in the emergence of psychoanalysis. By embedding his work in the story of mainstream somatic psychiatry, my book brings Freud into the history of medicine more broadly. The stories of psychoanalysis and pathological anatomy cannot be told independently of each other. From such a perspective, though neurology and psychoanalysis are often seen as opposed in their medical and scientific orientations, their common neuropsychiatric heritage enables me to construct a family tree on which Freud and Foerster appear as close intellectual relatives.²⁰

Not only can we trace Freud and Foerster's work back to the same institutional and pedagogical context; in addition they engaged with that context in similar ways. Freud no less than Foerster drew broadly on models of neuronal connections, and they both developed their practices through a criticism of the *Zentrenlehre* (one of the dominant forms of the localization tradition). More specifically, I argue that psychoanalysis and neurology emerged out of Freud and Foerster's break with the localization project as developed in neuropsychiatry, a break enabled by their deployment of connective principles.²¹

My concentration on the shared attributes of psychoanalysis and neurology means that my story cannot be taken as a full account of their emergence, nor indeed of Freud's and Foerster's careers. To provide a common frame for thinking about such diverse disciplines, it privileges particular aspects of their theory and practice, focusing on some strands rather than others. For this reason this is not a history of specialization, though it hopes to contribute to that literature.²² The processes of specialization are complex, and numerous factors, functioning differently in different national contexts, play roles.²³ The complexity of the task has led most histories of specialization in the mind and brain sciences to concentrate on one discipline or specialty, taking as their object of research a particular institution, an area of study, or a more or less coherent theoretical form and practice.²⁴

This study, however, is closer to those that provide dual histories of the brain and mind sciences by choosing a guiding thread—a practice, a function, a disease, or a concept that can be identified in a wide variety of disciplines—to construct their analyses. These histories have been able to think through the relationship between the brain and mind sciences by examining how different medical specialties and academic disciplines responded to and treated these shared elements. Just as their guiding threads are not constrained by disciplinary categories, these histories have been able to escape the limits of a soma-psyche distinction. For instance, Alison Winter and Kurt Danziger have written histories within the mind and brain, and more broadly the human, sciences by analyzing how different disciplines (psychology, neurosurgery, criminology, philosophy) discuss and study memory.²⁵ And Roger Smith, in his book *Inhibition*, explores how a shared language of “inhibition” cut across the European sciences of the mind and the brain, especially neurophysiology and psychology, from the second third of the nineteenth century.²⁶

Such an approach is valuable because it allows me to bring into conversation the sciences of mind and brain, and thus two of the fields that

inform modern thinking about subjectivity most authoritatively. In this way, this book contributes to the growing field of research on the history of the self.²⁷ It offers a way of moving beyond set oppositions between the somatic and the psychological, the cerebral and the psychoanalytic, subjects. Theories of and practices on the nervous system were not necessarily tied to a reductive somaticism, but rather provided resources for widely diverging understandings of subjectivity: self-transparent and self-opaque, learning and fixed, unified and divided, bodily and mental, solipsistic and social.

Localization and Its Discontents, by taking the changing and contradictory relationship between the connective and localizing traditions as its guiding thread, provides a new perspective on the developing medicine of the mind and the brain. Looking at the history of neuropsychiatry and its long shadows—crossing over the Atlantic, reaching across European borders, and especially across disciplinary divisions—we can shed light on the history of psychoanalysis and neurosurgery-neurology, which strongly resists the attempt to present them within the reified categories of “mind” and “brain,” the two cultures, the sciences versus the humanities. As the brain today gains in prestige as an object of scientific investigation and is invested with ever more extravagant hopes, such a history becomes particularly relevant. For in turning to the past we become aware of the contingencies, unexpected connections, and ironic narratives that will surely also mark our future.

Chapter Outline

The chapters in this book form a Y-structure. The base of the Y is made up of two chapters discussing the work of neuropsychiatrists Theodor Meynert and Carl Wernicke, which, I argue, provided resources common to both psychoanalysis and neurology. Beginning with chapter 3, I tell these symmetrical histories, which form the two arms of the Y. Chapters 3 and 5 examine the development of psychoanalysis, first Freud’s break with the neuropsychiatrists and then the transformation of his ideas in the work of Paul Schilder, an Austrian émigré to the United States. Chapters 4 and 6 treat the development of neurology-neurosurgery, looking first at Otfried Foerster and then at Wilder Penfield, a Canadian neurosurgeon. The book thus moves through a number of national and institutional contexts: from the morgue of Vienna medicine to the lecture hall in Breslau;

from the couch in Freud's Viennese middle-class practice to Foerster's exercise hall; and from there across the Atlantic to Schilder's clinic-based psychoanalysis and Penfield's operating room.

Though each chapter takes as its primary focus the work of a single practitioner, the book is not simply a set of case studies. As an account of the emergence of neurology-neurosurgery and psychoanalysis as independent medical fields, its examples are constitutive of broader trends. While Meynert and Wernicke were only two of a larger group of neuropsychiatrists in the latter decades of the nineteenth century, they were arguably the most prominent and influential. Freud's career path and intellectual development are not simply exemplary of psychoanalysis but were the single most important factor in its creation. Similarly, Foerster's path from neuropsychiatry to neurology is not merely a useful illustration of the changing face of neurological work in the period; as head of the prestigious *Gesellschaft deutscher Nervenärzte* from 1924 to 1932 and of the Rockefeller-funded Breslau Neurological Institute, he played a determinative role in the emergence of neurology as distinct from psychiatry. Penfield was one of the best-known neurosurgeons of the twentieth century and a figure of enormous influence in North American medicine. Even Schilder, who had perhaps the least institutional power of all my figures, is useful for considering the broader movement of psychoanalysis, because he became the epicenter of a debate that shook the New York Psychoanalytic Society. In each case, the way in which the doctor rearticulated the relationship between localization and connectivity was central, I argue, for the ongoing development of his field.

At the beginning of my story, and for the neuropsychiatrists, a connective principle (the reflex) was deployed in order to legitimate the localization project, and the mutually reinforcing relationship between the two took center stage. In chapter 1, I show how Meynert's appeal to a version of reflex physiology allowed him to participate in the new enthusiasm for pathological anatomy in Vienna medicine, which had risen to prominence in the political and cultural conditions created by the failure of the 1848 revolutions. To be able to apply the reflex (which previously had been restricted to spinal action) to the localization project (which took as its object the brain), Meynert revised the reflex model to make it appropriate for describing higher functions. Drawing on the language of association psychology, Meynert argued that between the afferent sensory arc and the efferent motor arc, there existed an "association system" that explained the complexity and "plasticity" of brain function. A modified re-

flex physiology thus emerged as a necessary resource for the localization project. At the same time, the appeal to associationism helped Meynert address a problem resulting from the organization of the Vienna General Hospital. Because pathological anatomy was centralized there, Meynert had to rely on his clinical colleagues for the description of symptoms that he would correlate with anatomical findings. Meynert's recasting of the *physiological* reflex paradigm through an appeal to association *psychology* helped facilitate the communication between somatically inclined pathological anatomists and psychologically oriented psychiatrists.

In chapter 2 I show how the reshaping of the medical landscape after Bismarck's insurance reforms in 1883 opened up space for a challenge to the localization project. Though Carl Wernicke made his name as a neuropsychiatrist, he became increasingly skeptical of the claim that discrete brain centers were responsible for discrete functions. I show this by examining Wernicke's clinical work in Breslau. He originally constructed his clinical demonstrations (*Krankenvorstellungen*) following the principles of neuropsychiatric localization, but the variety and complexity of the patient material led him to sideline that project. Drawing instead on Duchenne de Boulogne's "anatomy of the living," Wernicke began to present disease as the complex interaction of numerous nervous elements, and he reshifted the goals of his patient examination from the identification of a single lesion to the close description and interpretation of the patient's pathology. Wernicke's reflex practice showed itself to be resistant to the localization project for which it had been first deployed.

These tensions were only fully worked out by other figures, leading to two new conceptualizations of the normal and the pathological. In chapters 3 and 4 I show how Sigmund Freud and Otfried Foerster came to refigure the relationship between reflex and localization, broadly speaking, by emphasizing the systemic aspects of the first over the atomistic aspects of the second. Such a shifting of the relationship, I argue, allowed them to recast the Meynert-Wernicke understanding of nervous action and helped them form the two new disciplines of psychoanalysis and neurology.

Chapter 3 shows how Freud, working in the recesses of his apartment in Berggasse 19 in Vienna, was able to develop a new paradigm of disease and treatment that broke with central tenets of the localization tradition. Freud radicalized the associative elements of Meynert's connectivism in order to challenge the localizationist paradigm for which previously it was a support. First in *On Aphasia*, Freud used elements of Meynert's own system to challenge the then dominant theory of localization. Then

in later works, he challenged the lesion model upon which localization theory had been based. In doing so, Freud was able to reevaluate the etiology of mental disturbance, moving from an emphasis on physical to psychological trauma, and he recast the reflex exam as a form of “talk therapy.” Freud’s mature psychoanalytic practice, I argue, can then be seen as the ultimate rejection of the lesion and pathological anatomical model: because it dispensed with the “cathartic method” and focused on working through resistances, it was no longer structured by the identification and confrontation of an underlying “trauma.”

In chapter 4, we see how Foerster made a similar move, again drawing on the systemic aspects of the reflex in order to challenge the assumptions of the localization tradition. Working in the context of the neurological and neurosurgical departments of the Breslau state hospital, Foerster reconceptualized nervous disease by an appeal to a *Reflexgemeinschaft* (reflex community), which allowed him to sever the one-to-one connection between lesion and function that had been assumed in Meynert’s pathological anatomy: understanding it within the reflex system, Foerster showed how sensory damage could have motor consequences. That realization had important therapeutic consequences. Confronted with a flood of wounded soldiers after the Great War, Foerster developed a spinal-cord operation in which he would cut the reflex arc to isolate the pathological effects of a lesion. Later on, Foerster extended his operation to the brain in the treatment of epilepsy. Complementary to his surgical interventions, the “plastic” elements of Meynert’s reflex system were redeployed in order to draw on the organism’s own resources for change, in what Foerster called *Übungstherapie* (lit., exercise therapy). Because the nervous system could be shaped by experience, it was possible to establish a new “organization” of nerves, a process in which certain members of the “reflex community” were recruited for new tasks.

Chapters 5 and 6 foreground one further transformation. Chapter 5 looks into what became of Freudian psychoanalysis when the connective principles upon which it was based were discarded, by following the career of the psychoanalyst Paul Schilder. Schilder, who emigrated from Austria to the United States in 1928, styled himself as a psychoanalyst, but I argue that he remained far from the Freudian orthodoxy. While Wernicke and the early Freud emphasized the functioning of the whole reflex arc, in particular the set of associations connecting sensory to motor arcs, Schilder in his neurological tests treated the two separately. An important effect of this modification of reflex testing is that Schilder had to rely on

the patient's report for an account of her sensory experience. The reliance on this report in his clinical practice, I argue, encouraged Schilder's embrace of a self-transparent subject in his psychoanalytic theory, as seen in his rejection of the Freudian unconscious. Further, the debates over Schilder's ideas in the United States, resulting ultimately in his expulsion from the New York Psychoanalytic Society, shed light on deep conflicts within American psychoanalysis.

Chapter 6 charts a similar transformation of Foerster's practice. Wilder Penfield came to study with Foerster in Breslau in 1928 and brought Foerster's epilepsy operation back to North America. There it formed the basis of Penfield's clinical work. In contrast to Foerster, Penfield re-tasked his surgical technique in order to map the brain. I argue that the reemergence of the localization project, after a thirty-year hiatus, can be explained by Penfield's de-composition of the reflex. Like Schilder, Penfield tested both sides of the reflex arc separately, studying in turn sensory and motor responses. As such, Penfield could sideline the systemic aspects of the reflex that had structured earlier investigations and made localization so unconvincing. And like Schilder, Penfield was thus encouraged to posit a self-transparent patient who could provide insight into sensory states. As I show, the self-transparency of Penfield's introspective patient increasingly became the focus of his research, as in the 1950s he concentrated his efforts on tracking down an ever-elusive "mind."

In the epilogue I return to the theme with which I began this introduction and suggest ways in which this history sheds new light on recent trends in neuroscience—not to offer a full history of the present, but to exploit suggestive structural parallels between the history told in these chapters and neuroscientific developments of the past decade. I argue that a historically grounded understanding of the articulation of the relationship between localization and a principle of "connectivity" helps reframe anxieties about the place of neuroscience in contemporary academic culture, in particular in the humanities.