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Neuromy, education, and outreach in neuroscience: A historical case study of Burt Green Wilder

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ABSTRACT

Burt Green Wilder (1841–1925) was a pioneering naturalist and anatomist who is historically known for his brain collection and for his contributions to neuroanatomical nomenclature. During his 42-year career, Wilder also used brain measurements for education and outreach, especially in regard to issues of race and gender. Additionally, Wilder influenced neuroscience education and acted as a scientific liaison to the public. For example, he designed early implementations of the sheep brain dissections that are still being conducted today, as well as likely conducted the first “Brain Day.” This article reviews each of these topics, as well as others, with the aim of accurately placing Wilder in the history of neuroscience as a naturalist and anatomist who, among other achievements, pioneered the use of brain measurements for education and outreach.

KEYWORDS

Fusiform gyrus; Helen Gardener; lingual gyrus; neuroanatomy; Elizabeth Cady Stanton; women's suffrage

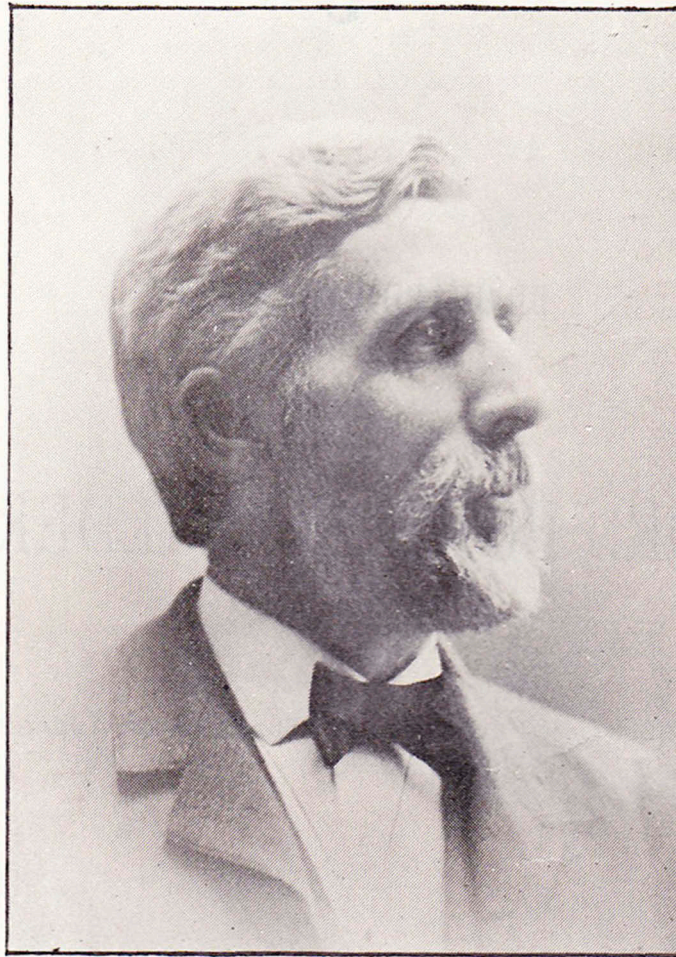
Brain measurements from the mid-nineteenth to the early-twentieth centuries extensively influenced society as brain exploration gained momentum, perhaps more so during this time period compared to any other in history up to that point (Huschke, 1854; Huxley, 1861; Ecker, 1869; Wernicke, 1876; Meynert, 1885; Wilder, 1885; Wilder, 1886; Sachs, 1892; His, 1895; Cunningham, 1896; Retzius, 1896; Smith, 1907). A key figure during this time period was naturalist and anatomist Burt Green Wilder (1841–1925; see Figure 1), who became a professor of comparative anatomy and zoology as one of the first faculty at Cornell University. Wilder is perhaps most well known for his brain collection, which was written up in the *New York Times*¹ nearly a century after his death. However, in this article, I present historical facts supporting that, although Wilder was a teacher with a brain collection, he also used brain measurements for education and outreach, especially in regard to issues of race and gender. Many anthropology books (Gould, 1981) and papers (Lewis et al., 2011) have been written about this time period, and specifically how measurements of the brain and skull were used to generate distinctions among races and genders. Franklin P. Mall is often identified as a key whistleblower identifying that measurements of the brain were flawed (Mall, 1909). However, Wilder was too (Wilder, 1909), although seldom mentioned. As such, Wilder's legacy of using brain measurements for education and outreach to the public has largely been overlooked.

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¹In <http://www.nytimes.com/2005/05/24/science/in-search-of-answers-from-the-great-brains-of-cornell.html>.

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BURT GREEN WILDER.

Figure 1. A portrait of Burt Green Wilder from the Physicians and Surgeons of America (Watson, 1889).

To fill this gap in knowledge and to accurately place Wilder in the history of neuroscience, this article is divided into nine sections. The first section gives a brief biographical sketch of Wilder. The second provides a synopsis of the importance he placed on neuroanatomical nomenclature, or *neuronymy*. The focus of the third section is Wilder's role in the discussion of race and brain measurements among anatomists. The fourth section shifts this focus from anatomists to the public, specifically discussing race, brain measurements, and outreach. The fifth discusses Wilder's role in the discussion of women's suffrage and brain weight. The sixth discusses the ironic use of *neuronymy* in the postmortem examination of Wilder's brain. The seventh

examines Wilder's role in the rare relationship among right brain, left brain, and "monsters." The eighth details how Wilder was particularly outspoken about sterilization of the "unfit" (Robinson, 1914, p. 13). Finally, the ninth expands on Wilder's goal to have brain measurements introduced into educational curricula as early as second grade and how, with this goal, he (a) likely conducted the first "Brain Day" and (b) likely generated one of the first brain dissection laboratories for precollege students (Wilder, 1897). Taken together, the combination of these details places Wilder in the history of neuroscience as a naturalist and anatomist who pioneered the use of brain measurements for education and outreach.

A brief biographical sketch

Burt Green Wilder (Figure 1) was born in Boston, Massachusetts, on August 11, 1841. He was descended from Nicholas Wilder (c. 1465–c. 1542), a German soldier who was a chief of the army of the Earl of Richmond in the Battle of Bosworth (Wilder, 1878). Nicholas Wilder received an estate on the Thames from Henry VII (1457–1509) with a coat of arms in 1497. He was also descended from Thomas Wilder, whose wife, Martha, came to America in 1638 with her children after Thomas' death. He was the son of David Wilder (1809–1891) and Celia Colton (Burt) Wilder (1812–1904), who both moved to Brookline, Massachusetts, in 1845.

Wilder's natural history studies began at the age of 14, when he started to record his observations of living spiders (Watson, 1889). At this young age, he caught the attention of naturalist Louis Agassiz (1807–1873), who invited Wilder to visit his laboratory at Harvard (it was Agassiz who later recommended Wilder as a founding faculty member at Cornell). Wilder graduated from Lawrence Scientific School at Harvard in 1862, during which time he studied comparative anatomy with Jeffries Wyman (1814–1874),² as well as attended courses by Agassiz. In May 1863, during the American Civil War, he became an assistant surgeon (and later a surgeon) of the Fifty-Fifth Massachusetts Infantry, until the regiment was discharged in September 1865 (Reid, 2010). Interestingly, his love of spiders collided with his role as a surgeon during the Civil War when, in Folly Island near Charleston, South Carolina, he discovered a large spider near where his regiment was positioned (Wilder, 1865). McCook (1894) later named this spider *Nephila wilderi*.

Due to his experience and expertise, Wilder was elected as professor of physiology, vertebrate zoology, and neurology at Cornell University on September 26, 1867. During his tenure, he published works on all aspects of anatomy, from the brain of ceratodus (Wilder, 1887) to the heart, eye, and brain of the sheep (Wilder, 1893) to the morphological value and relations of the human hand (Wilder, 1867). In terms of mentorship, he had an open-door policy (see Figure 2).

A remembrance of Wilder published in *Science* in 1925 directly reflects on the importance of Wilder's approach to students:

For many years, Dr. Wilder had no private laboratory, but pursued his investigations at a table in the general laboratory, where he was a constant inspiration to the students working there. The writer recalls vividly with what enthusiasm he used to call us about him in order to point out some step in advance in the research he was making. One can imagine nothing more stimulating to the young student than experiences of this kind. (Comstock, 1925, p. 532)

²Wilder started studying the skulls of humans and apes in 1859 under Wyman's guidance (Wilder, 1906). Wyman is credited with one of the first scientific accounts of the gorilla (Savage, 1847; Wyman, 1847). Wilder's experience with Wyman contributed to his public disagreement with writer Owen Wister, which is discussed later in the article.



Figure 2. A photo (c. 1910) of Wilder teaching in McGraw Lecture Hall to a room full of Cornellians. Wilder stands in front of the classroom beneath the depictions of two brains. Reprinted with permission of the Division of Rare and Manuscript Collections, Cornell University Library. ID Number: RMC2006_0056.

In 1893, to commemorate Wilder's time at Cornell, 16 of his former students who had become research pioneers—including David Starr Jordan, the first president of Stanford University and an influential ichthyologist—contributed original work to *The Wilder Quarter Century Book*, which is considered one of the first examples of the American version of the *Festschriften* (Reid, 2010).

Wilder retired from active service at Cornell on October 14, 1910, as the last member of the original faculty, after a career of 42 years (Figure 3). After his retirement, he lectured about his experience as a surgeon in the 55th Regiment, often incorporating knowledge about the brain into his lectures (Reid, 2010).

Neuronomy

Despite the breadth and depth of Wilder's contributions, he was passionate about clarifying the morphology of the brain and generating a principled methodology for labeling neural structures—a process he referred to as *neuronomy*, and to which he devoted over three decades of his career and life. Because nomenclature of not only the brain but also of all anatomical features of the body was described in practical atlases for surgeons and medical students in the mid- to late-1800s, a universal nomenclature was desired to reduce the multitude of anatomical names required for researchers and surgeons to memorize



Figure 3. A photo (c. 1910) of a neurology laboratory in McGraw Hall. Note the depictions of the two brains on the wall. The brains from these individuals were discussed in Wilder (1909). Reprinted with permission of the Division of Rare and Manuscript Collections, Cornell University Library. ID Number: RMC2005_0877.

(Weiner & Zilles, 2016). Concomitantly, naming was a fashionable topic of the time period, and Wilder's 1881 article received space in two different issues of *Science*, with an introduction by the editor (Wilder, 1881a, 1881b, 1896a). Wilder's collaborator, Simon H. Gage (1851–1944) (Wilder & Gage, 1882), later reflected:

In his work in neurology Professor Wilder became convinced that one of the greatest bars to the understanding of the nervous system, and indeed all of anatomy, was the ponderous, often conflicting nomenclature. He gave much time to a reform in this respect, and while his simple intelligible and consistent nomenclature has not been generally accepted yet the course of evolution is gratifying for what could not be ushered in all at once is coming in slowly and surely by the law of the “survival of the fittest.” (Gage, 1911, p. 361)

Contrary to Gage's optimism, Wilder's terminology was often considered too complicated to be universal. For example, some referred to his neuronymy as “Wilderese” and “Ithacan” (Shrady, 1886, p. 265), “scientific Volapük” (Baker, 1898, p. 716), or “philologic pedantry” (His, quoted in Wilder, 1896b, p. 272), due to the fact that his nomenclature was thought to resemble an entirely new language. Wilder's neuroanatomical nomenclature is further discussed in a later section, especially emphasizing his disdain for two macroanatomical labels—the fusiform and lingual gyri.

Race, brain measurements, and anatomists

During Wilder's tenure at Cornell (and also after), a prevailing neuroanatomical approach was to compare measurements from postmortem brains across races and sexes (Gratiolet, 1854; Huschke, 1854; Broca, 1861; Huxley, 1861, 1865; Meynert, 1867; Parker, 1896; Retzius, 1896; Spitzka, 1905; Bean, 1906; Spitzka, 1907; Mall, 1909; Smith, 1909; Wilder, 1909). Total brain weight, the sizes and weights of lobes, as well as gyral and sulcal patterning were measurements and features that were commonly compared. Additionally, there was a trend to perform these measurements on individuals considered "eminent"—for example, writers, scientists, composers, and philosophers (Spitzka, 1907)—as well as on criminals (Benedikt, 1881). One goal was to find neuroanatomical abnormalities—for instance, a lobe that was larger or a sulcal pattern more complex than in most other brains. Another was to locate neuroanatomical differences that could potentially differentiate one race from another or the sexes from one another. As pointed out by Franklin P. Mall (1909), two complications with these measurements were that they were from small sample sizes and not conducted in a blind manner.

To challenge the previous methods and findings from these studies, Mall physically reanalyzed brains that were used in the study by Bean (1906), who reported size differences in the genu and splenium between races. Unlike Bean, Mall (1909) analyzed 18 of these brains in a blind manner. Unable to replicate the differences, Mall wrote:

In this study of several anatomical characters said to vary according to race and sex, the evidence advanced has been tested and found wanting. It is found, however, that portions of the brain vary greatly in different brains and that a very large number of records must be obtained before the norm will be found. For the present the crude-ness of our method will not permit us to determine anatomical characters due to race, sex or genius and which if they exist are completely masked by the large number of marked individual variations. The study has been still further complicated by the personal equation of the investigator. Arguments for difference due to race, sex and genius will henceforward need to be based upon new data, really scientifically treated and not on the older statements. (1909, p. 32)

The same year Mall published his findings in the *American Journal of Anatomy*, Wilder had a publication of his own in the proceedings of the National Negro Committee Conference (which later became the NAACP), in which Wilder also quoted the above passage from Mall as well as referenced personal correspondences that Mall and he had with one another. Wilder agreed with Mall that the previous findings were flawed by the "personal equation of the investigator" and small sample sizes. In reference to the latter, Wilder wrote, "Surely no detailed arguments are required to expose the fallacies lurking in any comparisons of small numbers of specimens" (1909, p. 38).

Perhaps this is one of the reasons Wilder tried so hard to build a large collection of brains—1600, 430 of which were human brains of adults and children (Papez, 1929)—a large enough sample to differentiate even minor differences. Indeed, at the end of his 1909 proceedings, he asked a rhetorical question, one pitting minor differences in brain anatomy against moral courage:

Shall we now deny civil and political rights, and educational and industrial opportunities, to men merely because they are black, because the average weight of their brains is a little less, and because a certain region of the brain may be more frequently developed, when two thousand of their fellows, nearly half a century ago could manifest not merely the highest

kind of physical courage, but as high a kind of moral courage, as has been chronicled in the history of the world? (Wilder, 1909, p. 54)

To further highlight similarities between the brains of different races, as well as the flawed methodology of small sample sizes, Wilder compared the left hemisphere of a white jurist and politician to the right hemisphere of an illiterate black janitor (see Figure 4).

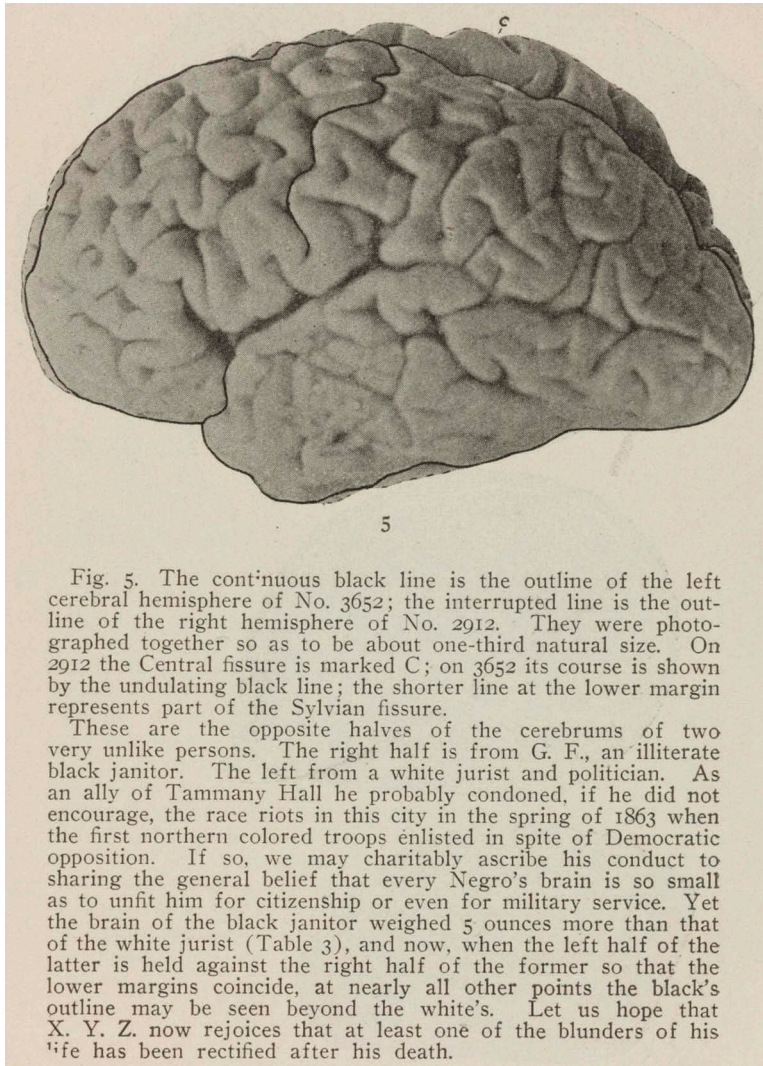


Figure 4. "These are the opposite halves of the cerebrums of two very unlike persons." This is an original image from Wilder's 1909 conference proceedings (Wilder, 1909). The original caption is included on the figure. The quoted text is taken from the original caption. Reprinted with permission of the Division of Rare and Manuscript Collections, Cornell University Library. ID Number: RMC2012_0011.

Altogether, the overarching theme of his presentation is perhaps best summarized by the third paragraph of his paper, in which he stated:

Respecting the brains of American Negroes there are known to me no facts, deductions, or arguments that, in my opinion, justify withholding from men of African descent, as such, any civil or political rights or any educational or industrial opportunities that are enjoyed by whites of equal character, intelligence, and property. (Wilder, 1909, p. 23)

W. E. B. Du Bois was in the audience and stressed that Wilder's presentation "left no doubt in the minds of listeners that the whole argument by which Negroes were pronounced absolutely and inevitably inferior to whites was utterly without scientific basis" (Du Bois, 1909, p. 408).

Race, brain measurements, and outreach

Wilder's passion for correcting scientifically incorrect information extended from conferences and academic papers to the general public. For example, *Alexander's Magazine*, published between 1905 and 1909, was considered a source of accurate information regarding the moral, intellectual, commercial, and industrial improvement of African Americans in the United States. Wilder published articles in *Alexander's* such as "Two Examples of the Negro's Courage: Physical and Moral," and openly responded to articles that perpetuated "political venom" (Wilder, 1906, p. 27). For example, in *Lady Baltimore*, a novel included as a series of installments in the *Saturday Evening Post*, the author, Owen Wister, depicted a scene in which a white man is presented three skulls: one from a Caucasian, one from an African American, and one from a gorilla. To Wilder's chagrin, a shopkeeper in this article presents "the story of the skulls as we know, from man-like apes through glacial man to the modern senator or railroad president" (Wister, 1906, p. 170). People assumed that Wister had generated an authoritative character to educate readers about accurate scientific facts regarding evolution and this infuriated Wilder, who openly ridiculed Wister and demanded a retraction. In doing so, Wilder stressed the fact that he trained with Wyman, who is credited with one of the first published scientific accounts of the gorilla, and started examining skulls of apes and humans under Wyman's guidance in 1859. Wilder was particularly displeased with Wister's "solution" to the problem, writing:

Neither the emendation, nor the disclaimer in the preface of a "feeling against the colored race" seem to me to constitute reparation for the original wrong. For one cultivated and discriminating reader of the volume there are probably ten who have been directly or indirectly misled by the statement in the periodical. In my judgment, especially in view of the declaration quoted above from the letter of Jan. 3rd, "he will take every step in his power to set the matter right," the author was and still is bound to publish an explicit retraction in the same periodical. A nearly equal responsibility rests upon the conductors of the periodical. (Wilder, 1909, p. 30)

Wilder attempted to ameliorate the "political venom" (Wilder, 1906, p. 27) that Wister's words generated by publishing the correspondences between himself and Wister's secretary. This would assure that there was at least a printed record indicating the scientific errors in Wister's story, as stated in this excerpt from *Alexander's Magazine*:

Even if the misstatement is qualified or retracted in the book form of “Lady Baltimore,” the atonement will be far from adequate. I print this note (and trust it may be reprinted) as an authoritative correction of an injurious scientific error, and as an antidote to the political venom that characterizes several passages of the story. (Wilder, 1906, p. 27)

Although Wilder believed that “the novelist may—or sometimes thinks he may—dispense with science” (Wilder, 1909, p. 26), he also believed that Wister’s defamatory words reflected an ignorance of the general public and other anatomists:

So far as known to me no other person protested against [Wister’s] original allegation. This might be taken to signify merely indifference. But it may also be interpreted as indicating a general lack of accurate knowledge respecting the skulls of apes and of races of men. Since such specimens are readily obtained and easily prepared, and since they are exhibited in all large museums and represented in comprehensive works, there may fairly be assumed an even greater and more widely spread ignorance concerning the contents of these bony cases. Such brains are far less easily obtained and preserved; in museums they are less common and less accessible; they are very complex (the human brain presents at least five hundred features, parts, and combinations of parts visible to the naked eye and provided with one or more names); and fewer anatomists devote themselves to their study and comparison. (Wilder, 1909, p. 30)

Taken together, whether speaking at the National Negro Committee Conference or attempting to right the wrongs published in novels and magazines, Wilder set a foundation for outreach in the early days of brain measurements that deserves acknowledgment in the larger context within the history of neuroscience.

Brain weight and women’s suffrage

Wilder’s experience as a surgeon in the Civil War and his expertise with spiders converged in many aspects of his writings and lectures. In a reflection on his experience during the war, he conveyed his belief that males are not always the dominant sex in terms of size and strength. Wilder used the spider he had discovered (Figure 5) during his service in the war as empirical evidence, asserting that “superiority and domination” (Wilder, 1919, p. 6) of females over males is possible in nature:

A striking example of feminine superiority and domination was found by me during my service, in the shape of a spider, *Nephila*, afterward described in scientific periodicals and (with illustrations) in the Atlantic for August, 1866. The female not only makes the net and catches the prey but weighs at least 100 times her mate; that is as if the average man of 140 pounds should attach himself to a woman of seven tons. Under such conditions Equal Suffrage would soon cease to be an academic question. (Wilder, 1919, p. 6)

Wilder was a champion of women’s suffrage (Reid, 2010) during a time when measurements of brain weight were affecting women’s societal roles. For example, differences in brain weight between women and men were being used as evidence against women being admitted to college, as well as being able to vote—ideas that were perpetuated by anatomists such as Theodor Ludwig Wilhelm von Bischoff (1872) and William A. Hammond (1884). The fact that many outside the scientific

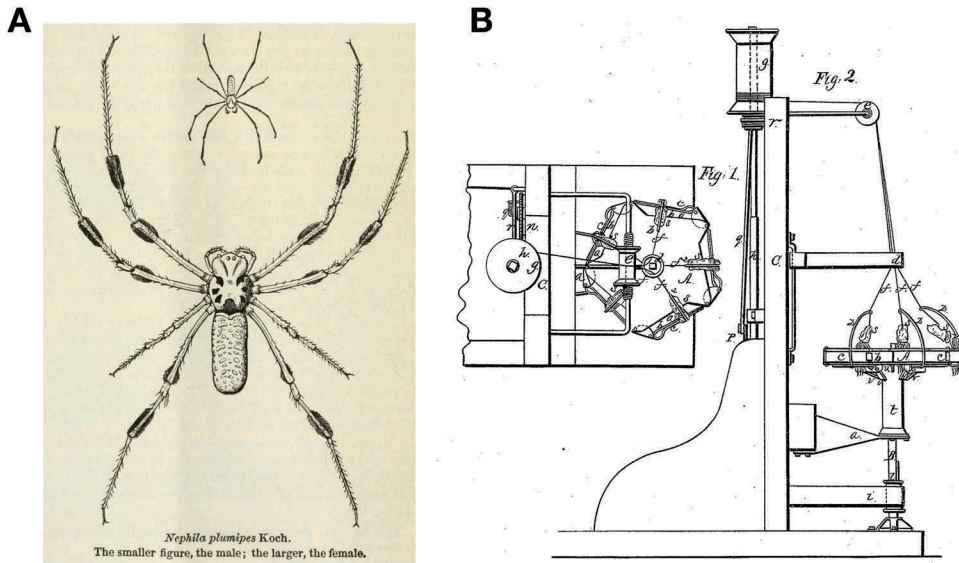


Figure 5. (A) In his essay, “Equal Yet Diverse,” Wilder discussed the complementary roles of men and women. Contributing to Wilder’s ideas was his expertise as a naturalist. For example, to support his ideas, he used examples of males and females in nature, such as the difference in the size and role of the female (bottom) and male (top) *Nephila plumipes* (later named *Nephila wilderi* by McCook [1894]), respectively. These images are depicted from his original discovery (Wilder, 1865) (see text for further explanation). (B) Wilder was so taken by the amount of golden silk *Nephila* could produce that he and two colleagues patented a machine to extract the silk more efficiently (Wilder, Wales, & Nichols, 1866). The spiders and other “silk-producers” sit on the platform (c), and the silk (f) is extracted and spooled as the platform spins.

circle were aware of these views is perhaps best illustrated by the following excerpt from the *Education Review* poking fun at the fact that Bischoff’s brain (postmortem) weighed less than an average woman of low intelligence:

The advocates of “woman’s rights” in Europe are enjoying a laugh at the expense of the late Professor Bischoff of St. Petersburg. Bischoff published a pamphlet some years ago in which he maintained that woman is incapable of higher education because her brain weighs on an average one hundred grams less than that of man. In his will he ordered that his own brain should be carefully weighed and predicted that it would weigh 1350 grams. To the general surprise, the result showed that the professor’s brain fell short, by five grams, of the weight of the brains of women of low intelligence. (Butler, Cook, Maxwell, & Poland, 1894, p. 520)

When considering the brains of men and women, Wilder emphasized that the evidence at that time could not support a division between the “intellectual manifestations” (Wilder, 1870, p. 40) of men and women. In an article published in *The Atlantic*, he wrote:

Although there are apparent and perhaps real exceptions among the animals as compared with each other, — the sheep’s brain, for instance, being more convoluted than the cat’s,—yet there is no question but that the human brain surpasses that of all others, — even that of the apes, — in the number and depth of its convolutions and the amount of the gray matter. But here, unfortunately, there are no materials for making such a comparison between the brain of man and of woman. If now we attempt to judge of them by the degree or quality of their intellectual manifestations, then we at once

diverge from the safe, though narrow highway of facts into the broad fields of individual estimates and opinions, which would indeed involve the begging of the very question which we are trying to solve. (Wilder, 1870, p.40)

In the same article, Wilder further argued against extrapolating meaning from a difference in brain weight:

It is evident, now, that neither absolute nor relative size proves anything; and even if it did, little help would be afforded in our estimate of masculine and feminine mental organs; for the proportion between the weight of the brain and that of the body is the same in the two sexes, or, according to some authors, a little larger in woman. (Wilder, 1870, pp. 39–40)

As the connection between brain weight and intelligence was publicly debated, these debates continued to affect women's right to vote and were extensively discussed in articles and textbooks about women's suffrage (Harper, 1922). Furthermore, famous suffragettes such as Elizabeth Cady Stanton (1815–1902) and Helen H. Gardener (1853–1925) (born Alice Chenoweth) donated their brains to Wilder's collection. Both of their brains made headlines. Stanton's brain was newsworthy not for its weight but because her sister refused to give it to Wilder, even though Stanton had bequeathed it to Wilder in her will (Figure 6A). Gardener's brain (Papez, 1927) was highlighted in the *New York Times* (Figure 6B) because it was just as heavy as Wilder's (who also donated his brain to the collection; Papez, 1929), which added another piece of evidence showing that the brain of a woman could be as heavy as that of a man. What was particularly interesting was that both brains were from champions of women's suffrage.

The ironic use of neuronomy in the post-mortem examination of Wilder's brain

As described, both Wilder and Gardener donated their brains to Wilder's brain collection. During the period after Wilder's death in 1925, Dr. James W. Papez, who would later make his mark on theories of emotion, was the secretary of the Cornell Brain Association. While Papez made headlines in the *New York Times* (Figure 6B) for the preliminary analyses of Wilder's and Gardener's brains, he also published full analyses of each brain in two separate papers (Papez, 1927, 1929). When closely examining the figures from the postmortem examination of Gardener's and Wilder's brains (Figure 7), it is evident that Papez referred to two gyri of ventral temporal cortex with labels that Wilder particularly despised—the fusiform and lingual gyri. Wilder abhorred the descriptive nature of these names, which can be attributed to Emil Huschke. Specifically, in 1854, Huschke ascribed the “fusiform” and “lingual” labels to these gyri because the former was spindle-shaped (e.g., wider in the center than at its ends), whereas the latter resembled a dog's tongue (Huschke, 1854; Weiner & Zilles, 2016). Because the calcarine and collateral sulci were primary sulci and easily identifiable in every hemisphere, Wilder suggested that the fusiform and lingual gyri should be labeled the *subcollateral* and *subcalcarine*, respectively (Wilder, 1896b). In this manner, these two gyri would always be identifiable in reference to these primary sulci. Wilder (1896b) stated the rationale for his dislike of the fusiform and lingual labels in a 136-page paper:

**A MRS. STANTON WILLED
AWAY HER BRAIN**

Devised It to Prof. Wilder of Cornell University, to Be Added to His Collection.

Special to The Globe.

ITHACA N. Y., Nov. 15.—Some two years ago Elizabeth Cady Stanton the noted woman suffragist, became interested in the collection of brains which Prof. Burt G. Wilder, head of the neurology department of Cornell university has gotten together in the interests of science and declared that she would put a clause in her will that upon her death Prof. Wilder should have hers to put on the shelves along with those of other noted men and women of the land.

Prof. Wilder said today that he had information that such a provision is in Mrs. Stanton's will. Upon her death he made application for the brain, but her near relatives objected and so far he has not received it. Prof. Wilder is in a great state of alarm because he had set considerable store on some scientific deductions which he might be able to draw from a careful analysis of the furrows and cells of the brain of the noted woman whose intellect was known to be so keen.

"Much will be lost to science," said the brain specialist tonight, "if the relatives of Mrs. Stanton are successful in preventing Cornell university from obtaining the brain of this great woman."

**B BRAIN OF MRS. GARDNER
IS STUDIED AT CORNELL**

**Dr. Papez Finds It Equal in
Weight to That of Dr. Burt
G. Wilder.**

Special to The New York Times.

ITHACA, N. Y., Sept. 2.—The brain of Mrs. Helen Hamilton Gardner, bequeathed to the Cornell Brain Association by the terms of her will, arrived at the College of Medicine here today from the Walter Reed Hospital in Washington, D. C., where it was removed following her death a few weeks ago.

Dr. James W. Papez, Secretary of the association, has begun a study of the organ.

Mrs. Gardner, an author, was the only woman member of the Civil Service Commission. Her brain is said to be normal, well proportioned and excellently preserved. It weighs the same as that of Dr. Burt G. Wilder, which was added to the Cornell collection upon his death last January. The weight of each is 1,150 grams.

The two brains will be studied side by side to prove or refute the theory in which Mrs. Gardner was so interested during her lifetime, that woman's mental capacity is potentially equal to man's. She treated this question in her book on "Sex in Brain."

Figure 6. (A) The fact that Elizabeth Cady Stanton willed her brain to Wilder's collection, but her sister refused to fulfill the request, was headline news. Here is an excerpt from the *Saint Paul Globe* (St. Paul, Minn., November 16, 1902) reporting the debacle. (B) A *New York Times* article from September 3, 1925, reporting that the brains of Wilder and Gardener were the same weight. Note the misspelling of Gardener's name in the headline.

Gyrus subcollateralis and *G. subcalcarinus*. – So slight is the resemblance of these cortical strips to the forms indicated in the commonly accepted *simile* names, *fusiformis* and *lingualis*, that I have never been able to remember their relative locations. It seems probable that the fissural names *calcarine* and *collateralis* are to persist. If so, is it not both logical and convenient to designate the gyres just ventrad of them by locatives indicating their positions, viz., *G. subcalcarinus* and *G. subcollateralis*? (p. 322)

Papez disregarded Wilder's nomenclature preferences. As illustrated in [Figure 7](#), Papez did not reference the gyri within ventral temporal cortex as subcollateral and subcalcarine, opting instead for fusiform and lingual. Wilder was not, however, the only one at this time arguing about how brain structures should be named, and this might have affected Papez's decision. In fact, Wilhelm His from Germany started his own committee on nomenclature, resulting in a list of

nomenclature (Wilder, 1896b).³ Between 1888 and 1895, the *BNA* cut the list of 30,000 names of anatomical structures (including eponyms and synonyms) to 4,500 (His, 1895; Barker, 1907). Wilhelm His and Wilder openly disagreed with one another, and Wilder included a series of letters exchanged between the two of them in his 1896 paper (Wilder, 1896b, pp. 294–300).

Many researchers after 1895 started to include terminology in the beginning of their atlases, and some even presented Wilder's terms in one column with *BNA* terms in another for comparison. The fusiform and lingual labels remained points of contention. The *BNA* sided with Huschke and did not approve of Wilder's subcollateral and subcalcarine labels. By 1929, the fusiform and lingual labels were still acceptable by the *BNA* (Weiner & Zilles, 2016), which is likely why Papez used the fusiform and lingual labels in the postmortem examination of the brains of Wilder and Gardener.

One irony within this historical story is that Wilder's concerns about the confusion resulting from how these gyri were being labeled did not abate. Specifically, in 1935, the fusiform and lingual gyri were again renamed, this time to lateral and medial occipitotemporal gyri, respectively (Kopsch, 1937; Adolf Pansch originally proposed these labels in 1866; see Weiner & Zilles, 2016). In more modern journal articles and atlases, these gyri are commonly referenced with multiple names (for reviews, see Federative Committee on Anatomical Terminology [FCAT], 1998; Petrides, 2012; Swanson, 2014; Weiner & Zilles, 2016; Federative International Programme on Anatomical Terminology [FIPAT], 2017; Ten Donkelaar et al., 2017; Ten Donkelaar, Kachlik, & Tubbs 2018).

The multiple labels still associated with these gyri make one wonder: Why didn't Papez stamp Wilder's own brain with the anatomist's preferred nomenclature? Even if the *BNA* nomenclature was an accepted way to label the brain in 1929, surely Papez could have given combinatory fusiform/subcollateral and lingual/subcalcarine labels, especially as Wilder had devoted much of his scientific career to neuronymy. Even the harshest reviewer or editor could understand this request. For example, and contrary to Wilder's situation, the postmortem examination of Carlo Giacomini's brain by Giuseppe Sperino in 1898 included the existence of Giacomini's band (a term coined by Retzius, 1896).⁴ Unfortunately Wilder did not have a choice, and his brain is forever stamped with the very labels that he adamantly and openly despised.

Right brain, left brain, and monsters

In 1874, Wilder reported on the brains from conjoined twins, which he referred to as a "double human monster" (Wilder, 1874, p. 250). "Monster" was often used to describe medical anomalies at this time.⁵ Indeed, in 1866, Fisher classified the many different types of conjoined twins in an essay about the characterization of "compound human monsters" (Fisher, 1866, p. 207). The epigraph⁶ of Fisher's essay traces back this nomenclature to Pliny the Elder, who, during the first century AD, referenced the vast types of "monsters"

³Wilder was appointed as a member of the committee on anatomical nomenclature at the 2nd Meeting of the Association of American Anatomists (the name was later changed to the American Association of Anatomists) held in Philadelphia in 1889.

⁴For details, refer to: https://oraprdnt.ugtr.quebec.ca/pls/public/docs/GSC233/F1017280946_Giacomini.pdf by Régis Olry.

⁵We have already uncovered a link between Franklin P. Mall and Wilder as whistleblowers to the flawed methods of their contemporaries, and there is also a link between the two when it comes to monsters. In particular, Mall also studied and wrote about monsters from a pathological and embryonic point of view (Mall, 1908).

⁶"Multiformes pluribus modis inter Monstra partus eduntur" (Fisher, 1866, p. 207).

born in the natural world in his Book VII of *Naturalis Historia*. Specifically, what Fisher refers to as *Diploteratology*⁷ built on Pliny's original descriptions. So, what was Wilder's interest in monsters?

As noted, definitions and names of sulci and gyri were still being determined in the late-nineteenth and early-twentieth centuries. As such, understanding their variability across individuals, and even between the hemispheres of the same individual, were topics of great interest to Wilder and other anatomists. Wilder's case of *Dicephalus, tribrachus tripus* (Wilder's classification based on Fisher's terminology) offered the rare opportunity to compare four hemispheres attached to the same body, and he described this rarity as follows:

It is generally known that the right and left hemispheres often present considerable differences in the details of the cerebral pattern; but very rarely do we find figures or detailed descriptions which indicate the extent of this lateral variation, although its existence would seem a serious difficulty in respect to phrenology. As remarked in a previous paper no brains of different individuals can be so closely allied as those of the same individual, and a study of these must serve to check our estimates of the zoological value of fissural variation between species; next in value for this purpose would usually be ranked the brains of twins or, with animals, brothers and sisters of the same litter; but an intermediate stage of relationship is presented by double monsters, like the one described in the next paper, and as their brains are rarely preserved or figured, I have thought them worth recording. (Wilder, 1874, p. 250)

It is worth reiterating that it is not the case that other scientists did not have access to conjoined twins. Instead, as Wilder wrote, the rarity is in the fact that "their brains are rarely preserved or figured" (Wilder, 1874, p. 250). Indeed, three decades later, there were reports on *dicephalous monsters* in the *Journal of the American Medical Association* (West, 1905; Caffey, 1906), which only included photographs of the stillborn children and reports of the cases, but did not include examinations of the brains.

Aside from the rarity of the documentation, the findings from Wilder's examination were not groundbreaking. Wilder reported that the complexity of the fissures in both hemispheres of the left brain are greater than in both hemispheres of the right brain, noting:

[I]t is evident that all the fissures differ greatly as to length, direction, branches and connections, and that the smaller fissures vary considerably in number, giving an appearance of fissural complexity in the following order. 1. Left brain, left hemisphere; 2. Left brain, right hemisphere; 3. Right brain, right hemisphere; 4. Right brain, left hemisphere. (Wilder, 1874, p. 251)

The images depicted in Wilder's proceedings provide an interesting historical contribution to the right brain vs. left brain discussion. To remind the reader, the pioneering experiments from Sperry, Gazzaniga, and others (reviewed in Finger, 2000), revealed a striking functional independence between the two hemispheres of a single brain once the callosum is severed. However, in these experiments, the *right brain* is the right hemisphere and the *left brain* is the left hemisphere, but together, the two hemispheres anatomically form one brain despite their functional differences. Although theoretically unrelated to the right brain vs. left brain debate, Wilder's figures might be the first images labeled as *right brain* and *left brain* in the literature (Figure 8).

⁷*Teratology* can be considered a branch of embryology dealing with abnormal development and congenital malformations. *Diploteratology* can be considered a branch of teratology focused on conjoined twins.

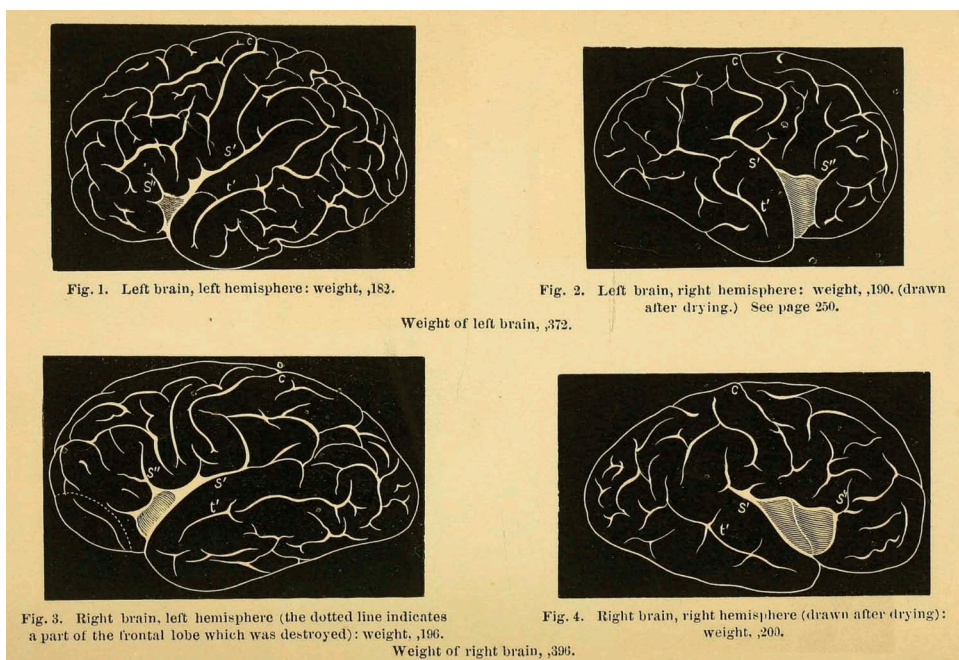


Figure 8. Original images and captions from Wilder (1874). Left and right hemispheres for the left (top) and right (bottom) brains from conjoined twins. Original captions are included below each image.

On sterilization

Toward the last decade of Wilder's life, eugenics was on the rise. His former student at Cornell, David Starr Jordan, along with Grafton Elliot Smith, a well-known anatomist, were advocates of eugenics. As far as is known by the present author, Wilder was not associated with a racial aspect of eugenics, but he was associated with a movement for the "sterilization of the unfit" (Robinson, 1914, p. 13).

Specifically, in the January 1914 issue of *Medical Review of Reviews*, Victor Robinson edited an article titled "A Symposium on Sterilization of the Unfit." Wilder was a contributor (as a physician) and Comstock (who was quoted earlier in the present article from Wilder's obituary in *Science*) was a contributor as a sociologist. Robinson introduced this article with the following text:

A phase of eugenics that has occasioned considerable discussion is the question of the sterilization of the unfit. Should the State prevent certain individuals from increasing population? Should Vasectomy and oöphorectomy become legal operations?

To this important query, the MEDICAL REVIEW OF REVIEWS has received responses from several distinguished gentlemen, and it will be seen that some advocate the measure with enthusiasm, that others denounce it with equal earnestness, while still others look at the matter thru the spectacles of either neutrality or uncertainty. (Robinson, 1914, p. 13)

Wilder, considered by Robinson "the most eminent anatomist in America," contributed a response. The text is quoted as follows:

We are pleased to submit a reply from the most eminent anatomist in America – Professor BURT GREEN WILDER:

“Sterilization of the unfit (under proper safeguards of course) is advocated by me as the logical ultimatum of two convictions, viz., quality of population is far more essential than number, and the human race should consciously and voluntarily improve itself and not alone the breeds of domesticated animals. These convictions were formulated nearly forty-five years ago, i.e., soon after, at the request of Andrew D. White, first president of Cornell University, I undertook the hygienic instruction in that institution. Later my little “Health Notes for Students” quoted, with approval, the following passage:

‘Paupers and criminals should be prevented from marrying. The tramp and the malingerer should be stamped out; they need not exist. It is as harmful to bring insane children into the world as it is to drive them insane by bad usage. The habitual criminal man or woman should be deprived of the power to procreate.’

The last sentence need only include ‘by operative procedure’ to express the most radical opinion of today.” (Robinson, 1914, pp. 14–15)

Indeed, Wilder’s *Health Notes for Students* (1883) contained a variety of ideas regarding alcohol use, smoking, morality, and self-control. All of these issues are beyond the scope of the present article, especially so because they are more about Wilder’s opinions than his anatomical, education, outreach, and neuroscientific contributions. Still, they are briefly mentioned here for historical completeness.

Wilder’s role in the origin of ‘Brain Day’ and dissections of sheep brains

Today, graduate students and postdoctoral fellows in the neurosciences frequently travel to nearby schools to get young students excited about the brain. These Brain Days often occur during Brain Awareness Week.⁸ Over a century ago, Wilder conducted what might have been the first Brain Day, with the goal of different levels of brain education in grammar school, primary school, and high school. Wilder’s words describing a need for brain awareness in classrooms and among the “laity” in his 1897 article in *Science* are still relevant:

NEVER before has the need of information as to the structure and function of the nervous system been so keenly felt by experts in various branches of knowledge and by practitioners of various specialties.

Never before, likewise, has there been so general and so earnest a desire for such in-formation among the laity. ...

Under prevailing conditions, however, any approximation to a real and accurate knowledge of the brain is gained by but few, and at a late educational stage. Hence the public are ignorant or misinformed,* and the time that specialists might devote to research and advanced instruction is consumed in acquiring and imparting the neurologic alphabet. Indeed, so numerous are the parts of the central nervous system,* so heterogeneous and unfamiliar are their appellations, so complex are their connections, so subtle and interdependent are their operations, so multifarious and difficult are histologic and physiologic manipulations, so diverse are the interpretations of nervous phenomena, and so voluminous is the literature of neurology, that by the time existing knowledge is fairly mastered the would-be investigator has too often passed the period of greatest energy, enthusiasm and opportunity. (Wilder, 1897, pp. 902–903)

⁸<https://www.sfn.org/public-outreach/brain-awareness-week>

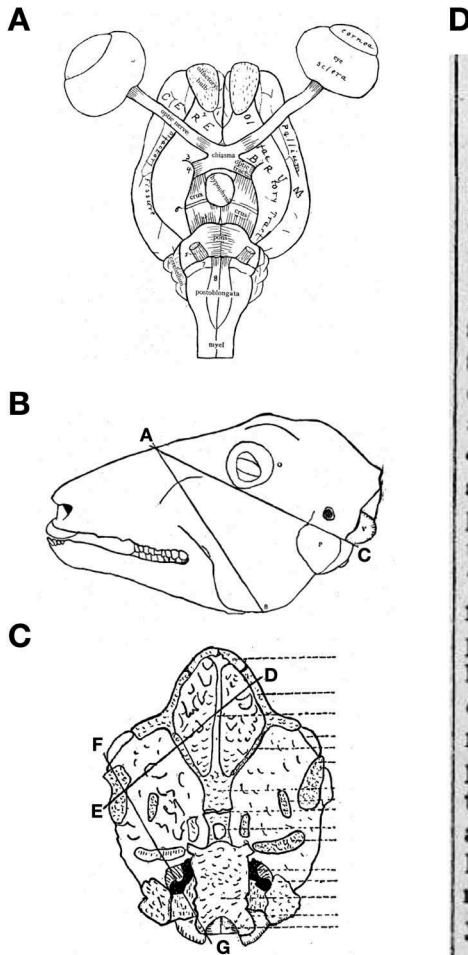


Figure 9. Today, you can buy sheep brains online for less than ten dollars. Before sheep brain dissections were commonplace, Wilder proposed this dissection exercise in an 1897 *Science* paper. (A) The “base or ventral aspect of the sheep’s brain with eyes attached; slightly enlarged” (Wilder, 1897, p. 904, Figure 1). (B) A skinned sheep head with lines indicating how to remove most of the face to expose the cranium (Wilder, 1897, p. 905, Figure 2). (C) The ventral aspect of the cranium after removal from the line A–C in (B). Wilder further instructs the following: “If the parts outside the line D–E and F–G are sawn off the brain may be exposed by nippers” (Wilder, 1897, p. 906, Figure 3). It should also be stated that Wilder did not take credit for the method described in his paper and depicted in these images. Instead, in a footnote, he credits Dr. P. A. Fish: “Sometimes the butchers can be employed to extract the brain after a rough fashion as if for food; but it is removed most safely and easily according to the method devised by P. A. Fish, described by me, before the American Society of Naturalists, and indicated upon Figures 2 and 3” (Wilder, 1897, p. 905). (D) Wilder’s ideas were not restricted to scientific journals but reached doorsteps throughout the United States. Here is an excerpt from the *Louisiana Populist* of January 1, 1897, reporting Wilder’s ideas regarding the utility of examining the brain and of students understanding the topography of their own cerebrum.

One of Wilder's solutions to this problem was to write and distribute a brain dissection manual for students. That exercise of how to dissect a sheep brain was the bulk of his article (Figure 9). Even though the impact of his article is voluminous and variations of his proposed dissection are still carried out in classrooms today, what he did is rarely acknowledged. Furthermore, his article provides the first documentation of an actual Brain Day. Specifically, Wilder reported teaching 40 second graders (between the ages of seven and 11) different aspects of the sheep brain, including 20 names of brain structures. He also had the teacher give the students a surprise quiz after two months had passed. He reported that they were able to remember most of the structures, because their names are no more complicated than other words that children learn and remember:

Children have no prejudices against words of classical origin. *Hippocampus*, *rhinencephalon*, *hypophysis*, *fornix*, and *callosum* would be accepted quite as readily as *hippopotamus*, *rhinoceros*, *hypotheneuse*, *appendix*, and *chrysanthemum*. (Wilder, 1897, p. 904)

Wilder's ideas were not only conveyed in *Science* but also reached the doorsteps of the American people in various newspapers (Figure 9).

In one of his last letters to *Science*, Wilder conveyed a series of nine lessons he thought were the most important in his 50 years of experience and 42 of teaching. His ninth lesson is, "The objective study of the brain should begin in the primary school . . . the high school graduate should have gained as much real knowledge of the human brain as is now possessed by the average graduate in medicine" (Wilder, 1911, p. 121).

Conclusions

Burt Green Wilder devoted a bulk of his 42-year career to clarifying the morphology of the brain and for generating a principled methodology for labeling neural structures. He was extremely prolific, publishing 35 articles and letters in *Science* alone, three of which were devoted to the labeling of brain structures (Wilder 1881a, 1881b, 1896a). Additionally, he used brain measurements for education and outreach. Wilder not only pioneered brain measurements, and anatomical measurements more generally, but also made the brain and scientific measurements headline news throughout the United States.

Wilder became a household name in late-nineteenth- and early-twentieth-century America, with nearly 200 newspaper articles written by him or about him. The topics of these articles ranged from his ideas about incorporating the brain into school curricula (Figure 9) to arguments with President Woodrow Wilson about intercollegiate sports (especially football),⁹ why he was adamantly against smoking,¹⁰ and how he composed a musical piece—his *Fiat Justitia*, which he dedicated to another president, Theodore Roosevelt.¹¹

Burt Green Wilder was much more than a teacher with a brain collection. Wilder contributed in a myriad of significant ways to the neurosciences.

⁹"Football or No Football: The question discussed by Profs. Wilson and Wilder," *The New York Times*, February 18, 1894.

¹⁰B. G. Wilder, "Collected reprints [1871–1905]," p. 136. (<http://hdl.handle.net/2027/coo.31924003391368>).

¹¹B.G. Wilder, "Collected reprints [1871–1905]," p. 16–19. (<http://hdl.handle.net/2027/coo.31924003391368>).

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