The historical origin of the term “meningioma” and the rise of nationalistic neurosurgery

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The historical origin of the meningioma nomenclature unravels interesting social and political aspects about the development of neurosurgery in the late 19th century. The meningioma terminology itself was the subject of nationalistic pride and coincided with the advancement in the rise of medicine in Continental Europe as a professional social enterprise. Progress in naming and understanding these types of tumor was most evident in the nations that successively assumed global leadership in medicine and biomedical science throughout the 19th and 20th centuries, namely, France, Germany, and the United States. In this vignette, the authors delineate the uniqueness of the term “meningioma” as it developed within the historical framework of Continental European concepts of tumor genesis, disease states, and neurosurgery as an emerging discipline culminating in Cushing’s Meningiomas text.

During the intellectual apogee of the French Enlightenment, Antoine Louis published the first known scientific treatise on meningiomas. Like his father, Jean-Baptiste Louis, Antoine Louis was a renowned military surgeon whose accomplishments were honored with an admission to the Académie royale de chirurgie in 1749. His treatise, Sur les tumeurs fongueuses de la dure-mère, appeared in 1774. Following this era, growing economic depression affecting a frustrated bourgeoisie triggered a tumultuous revolutionary period that destroyed France’s Ancien Régime and abolished its university and medical systems. The resulting anarchy was eventually quelled through legislation aiming to satisfy Napoleon’s need for qualified military professionals, including physicians and surgeons. These laws laid the foundations for the subsequent flourishing of French medicine throughout the mid-19th century. Subsequent changes to the meningioma nomenclature were authored by intellectual giants of this postrevolutionary period, for example, by the Limoges-born pathologist Jean Cruveilhier known for the term “tumeurs cancéreuses de la dure-mère,” and the work of histopathologists, such as Hermann Lebert, who were influenced by Pasteur’s germ theory and by Bernard’s experimental medicine.

The final development of the meningioma nomenclature corresponded to the rise of American neurosurgery as a formal academic discipline. This historical period of growth is chronicled in Cushing’s text Meningiomas, and it set the scientific stage for the modern developments in meningioma research and surgery that are conducted and employed today. http://thejns.org/doi/abs/10.3171/2015.10.JNS15877

KEY WORDS meningioma; Harvey Cushing; Hermann Lebert; history of neurosurgery; history of medicine

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ABBREVIATIONS ARC = Académie royale de chirurgie.
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The French Enlightenment: Antoine Louis

The organized advancement of medical science in Western Europe has been described as beginning in the late 18th century and continuing through the pre-Listerian era of the mid-19th century; the French led most of the
advances made during this period. It was during this time, in the final years of the French Enlightenment, that the French military surgeon Antoine Louis (Fig. 1) produced the first known scientific publication exclusively describing meningiomas. This historical period was marked by intense intellectual productivity, creativity, and academic competition during the reign of the relatively weak monarchies of Louis XV and Louis XVI.

Born in 1723 in Metz, France, Louis completed his classical studies with excellence at the Collège des Jésuites of his native town. He was inspired by the example of his father and mentor, Jean-Baptiste Louis, then a renowned surgeon at the military hospital. Early on, Antoine Louis’s growing reputation and talent in surgery was soon recognized by François Gigot de La Peyronie, who was first-surgeon to King Louis XIV and founder of the Académie royale de chirurgie (ARC). La Peyronie therefore recruited the young surgeon to Paris, where Louis began an illustrious career. In 1746, Antoine Louis was elected member to the ARC, and in 1749, he successfully defended a thesis in Latin on head trauma, called Propositiones Anatomicae et Chirurgicae de Vulneribus Capitis. In 1764, he was elected perpetual secretary of the ARC, an event that marked the beginning of the most productive and brilliant period of his life. Antoine Louis made his key contribution to neurosurgery by publishing in the Mémoires of the ARC the first scientific treatise devoted exclusively to meningiomas: “Sur les tumeurs fungueuses de la dure-mère.” This term, translating into English as “fungoid tumors of the dura mater,” is therefore acknowledged as the first major attempt at naming meningiomas.

19th Century France: Revolution and Jean Cruveilhier

Following the French Enlightenment, a series of events ushered in social changes. These changes occurred in response to a period of economic depression affecting the bourgeoisie. Three years later, Louis the XVI was deposed, and France entered a politically fractious period that was marked by war, revolution, and an evolving educational structure. During this period of instability for the Ancien Régime, French revolutionaries abolished universities and destroyed a fiercely criticized medical system that had been characterized by division and rivalry.

This unstable period was followed by a decade of economic liberalism marked by political and educational anarchy. Eventually, the Napoleonic wars created a need for the preparation of qualified military professionals, including physicians and surgeons, and as a result, a tiered system of medical education was established. Eventually, the Napoleonic wars created a need for the preparation of qualified military professionals, including physicians and surgeons, and as a result, a tiered system of medical education was established.

The next major change in the meningioma nomenclature was authored by Jean Cruveilhier (Fig. 2), a distinguished pathologist and clinician born in Limoges, France, in 1791. Like his predecessor Antoine Louis, Cruveilhier was the son of a surgeon and was mentored by the leading surgeon of early 18th century France, Guillaume Dupuytren. Cruveilhier’s work on meningiomas is the subject of a paper by Bakay and will be described only briefly here. Cruveilhier devoted a chapter to the description of meningiomas in his magnum opus, L’anatomie pathologique du corps humain, a text whose illustrations are celebrated for their unrivaled beauty in the history of pathology. Sample illustrations from the chapter called “Des Tumeurs Cancéreuses des Meninges” are shown in Figs. 3 and 4.

As noted by Cushing in his 1938 monograph, Cruveilhier’s work refers to these tumors interchangeably as “tumeurs fungueuses” and “tumeurs cancéreuses internes de la dure-mère.” Cruveilhier also uses the term “tumeurs carcinomateuses de la dure-mère,” asserting his belief, at the time, that these lesions were of a malignant nature. Cushing notes, however, that when Cruveilhier came to write his Traité d’anatomie pathologique générale in 1856, he began to reconsider whether these fungoid tumors were, in fact, cancerous. In this later work, Cruveilhier writes, “To explain all of my thinking regarding tumors of the dura mater, I will say that we apply rather delicately the term ‘cancerous’ to tumors that can persist for many long years without propagating by continuity of tissue to neighboring regions; such are the tumors born at the internal surface of the dura mater.”

FIG. 1. Portrait of Antoine Louis (1723–1792). Public domain; courtesy of the National Library of Medicine.
One of Cruveilhier’s British contemporaries, the celebrated pathologist Richard Bright, was less committal in his own characterization of meningiomas. Born in 1789, the son of a wealthy merchant and banker, Bright was broadly schooled in natural philosophy, political economy, and mathematics before completing his medical training at Guy’s Hospital in London and at the University of Edinburgh.34,45 His prolific and artistic contributions to neurology and neuropathology nearly rival the work in nephrology for which he is primarily remembered.24 In his most well-known publication, Bright offers, regarding meningiomas, that the tumors were of a “…fungoid character, of slow growth and lobulated in structure”; he further proposed that they originate from the dura mater, “…or rather perhaps from the arachnoid lining the dura mater.” Bright avoids, however, explicitly naming these tumors.17

The Period of French Leadership in Medicine

The tumultuous political and sociocultural backdrop to the ensuing era of the 19th century did not curtail the innovations in intellectual life that continued throughout this period. The political ruptures of this epoch included the following: the first and second Bourbon Restorations, briefly interrupted by Napoleon’s Hundred Days in 1815; the Revolution of 1830, followed by the July Monarchy of King Louis-Philippe (1830–1848); the Second Republic, named in honor of the revolutionary era that followed the initial rise of Napoleon; and the Second Empire of Napoleon III (1852–1870) and its subsequent collapse during the Franco-Prussian war of 1870 and establishment of a Third Republic in the same year.11

Innovations in clinical and experimental medicine were similarly dynamic. Early doctrines such as the bloodletting practices of François-Joseph-Victor Broussais, also known as “le vampire de la médecine,” were slowly supplanted by more logical, scientifically grounded approaches such as the statistics-driven medical reasoning of Pierre-Charles-Alexandre Louis.19,25 The work of François Magendie in 1822 on functional divisions of the spinal cord and the later work of his illustrious pupil, Claude Bernard, on autonomic physiology, marked the dawn of experimental medicine and laid the foundations for modern French neurology and biomedicine.11 Pioneers of French neurology and neurosurgery who also thrived during this period included the great surgeon and anthropologist Paul Broca (1824–1880), the father of neurology Jean-Martin Charcot (1825–1893), Charcot’s protégé Charles-Joseph Bouchard (1837–1915), and Bouchard’s neurological rival Joseph Babinski (1857–1932).12

FIG. 2. Photograph of Jean Cruveilhier (1791–1874). Public domain; courtesy of the National Library of Medicine.

FIG. 3. From Cruveilhier, Anatomie Pathologique Du Corps Humain: 8 Livraison Plate 2 (Cancerous Tumors of the Meninges). Public domain; courtesy of the University of Iowa Libraries. Figure is available in color online only.
Perhaps the most notable medical scientist of the 19th century was the French microbiologist Louis Pasteur (1822–1895), who was born in the city of Dole, near the Swiss border. After early schooling in Arbois and Besançon, Pasteur earned admission to the prestigious École normale supérieure where he completed graduate training in physics and chemistry before shifting his interests in crystallography toward the problems of biomedical science. His pioneering work on fermentation led to his conceptualization of the germ theory of disease.\textsuperscript{40} The impact of Pasteur’s work on medicine, microbiology, and the post-Listerian era of surgery is, perhaps, incalculable. Moreover, Pasteur and his archrival, Robert Koch (1843–1910), personified a bacteriological feud between the scientific institutes of France and Germany that made the microscope an instrument of growing importance in experimental medicine.\textsuperscript{3} The emerging focus on microscopy marked a shift from autopsy-based gross anatomical knowledge toward the emerging disciplines of histology and histopathology. Germany, in particular, became increasingly ambitious in promoting cellular analysis by means of microscopic technology.\textsuperscript{5}

**Franco-Prussian Influence and Hermann Lebert**

The aforementioned shifts laid the foundation for the histogenic era in the meningioma nomenclature. As Franco-Prussian tension was mirrored by the growing competition between French and German schools of histopathological and biomedical thought, it is interesting to note how these camps were scientifically linked in the personality of Hermann Lebert (Fig. 5). Born in 1813 in the formerly Prussian city of Breslau, Lebert’s parents lived primarily in Berlin but fled to Lebert’s birthplace to temporarily escape conditions caused by one of the Napoleonic wars (1813–1814). Besides receiving a medical doctorate in Zurich in 1834, Lebert researched and received a doctorate in botany before spending 18 months practicing medicine. In Paris, he was a student of the aforementioned surgical giant Guillaume Dupuytren and the physician-pathologist Pierre-Charles-Alexandre Louis, and he also attended the microscopy courses of a prominent French clinician named Alfred François Donné. Lebert’s close friends and colleagues included the French clinicians Charles Robin and Paul Broca. Additionally, during a brief stay in Berlin in the winter of 1845–1846, he also made the acquaintance of the great German pathologist, Rudolf Virchow (Fig. 6), before returning to Paris in 1846.\textsuperscript{37}

![Fig. 4. From Cruveilhier, Anatomie Pathologique Du Corps Humain: 8 Livraison Plate 3 (Cancerous Tumors of the Meninges). Public domain; courtesy of the University of Iowa Libraries. Figure is available in color online only.](image1)

![Fig. 5. Portrait of Hermann Lebert (1813–1878). Public domain; courtesy of the National Library of Medicine.](image2)
In his 1851 treatise on cancer histopathology, Lebert offers the term “…tumeurs fibro-plastiques intracrâniennes” in the chapter describing tumors of the CNS.27 His descriptions are notable for their striking detail in both gross and microscopic observation: …The intracranial fibroblastic tumors demonstrate, in most cases, a rather intimate connection to the meninges. They sometimes take their origin from the dura mater, sometimes from the arachnoid, and they are marked by the particularity of practically no adherence to neighboring regions…. They can compress the brain, the cerebellum, the nerves and the bones, invade neighboring organs creating casts and cavities, but without bringing about the slightest fibroblastic change…27

Lebert’s microscopic description of one specimen explains his choice of nomenclature: “…it was a flat tumor, with a sarcomatous redness and a scattered osseous lattice, devoid of cloudy liquid and upon microscopic examination, demonstrating properties found only in fibroplastic tissues.”27 Further assertions about the nature of Lebert’s “tumeurs fibro-plastiques” follow, such as the complete delimitation of the lesion relative to neighboring structures, the meningeal origin, and the microscopic observations that suggest an absence of malignant or cancerous elements; Lebert therefore concluded that the tumors are benign.27 Several years later, however, Lebert refines his own perspective, dividing the tumors into two groups: those with a more benign behavior and those with a propensity for malignancy.17,28 As noted by Cushing, Lebert’s contribution to meningioma nomenclature and neuropathology in the mid-19th century was immortalized by the citations of his work in the publications of Cruveilhier and, more significantly, Virchow.15,17,42

**Virchow and German Leadership in Medicine**

As a pioneer of foundational principles of biomedicine such as the modern concept of the cell theory, pathophysiological foundations of venous thromboembolism, and the structure and function of neuroglia, Rudolf Ludwig Karl Virchow (1821–1902) is easily considered the most prominent German physician of the 19th century and one of the most prominent physicians in the history of medicine.35 William Osler, a lifelong teacher and mentor of Cushing, said the following of Virchow: “The lesson which should sink deepest in our hearts is the answer which a life, such as Virchow’s, gives to those who today, as in past generations, see only pills and potions in the profession of medicine, and who, utilizing the gains of science, fail to appreciate the dignity and the worth of the methods by which they are attained.”7,32

Virchow’s contributions to the meningioma nomenclature included description of the granules seen in some specimens, for which the Greek term for sand was borrowed to label these tumors as “psammoma”: “One can therefore describe the tumor as, ‘brain sand tumor,’ for which the name, ‘Psammoma,’ is suggested (Psammos = Sand).”6 Virchow’s voice of authority in pathology drew attention away from other contemporaneous attempts to name and describe the tumors, such as the suggestion by British surgeon and pathologist Sir James Paget,17,33 or the term “aceruloma,” proposed by Virchow’s compatriot, Heinrich Meckel.17,36,41 Other terminology proposed by Virchow is evident in the fourth quote, introducing Cushing’s *Meningiomas* monograph:

It’s worth mentioning a so-called “Fungoid durae matris”—which has often been written about, but generally remains unclear in literature. This brings me back to the question of cancer, since it’s undoubtable, that a certain amount of the described patient cases are in fact, cancer. But it’s also undoubtable that there is Sarcoma of the Dura Mater. This sarcoma however usually sits internally, in the direction of the skull space…and not externally, on the side of the bone.17,36

In this manner, Virchow asserted his belief that the tumors were of a sarcomatous nature, despite lending support to Lebert’s earlier claims regarding the benignity of these lesions.17,36

The Franco-Prussian war and confusion over the most appropriate term for meningeal tumors, dubbed “nosological hairsplitting” by Cushing, spread throughout Central and Western Europe throughout the rest of the 19th century.17 Lebert’s “tumeurs fibro-plastiques” was supplanted by terms such as “epithelioma” proposed by Charles-Philippe Robin and “endothéliome” proposed by Charles-Joseph Bouchard.9,10,17,38 The term “endothelioma,” which Cushing attributed to an 1869 article by the preeminent
Italian physician Camillo Golgi, began to earn growing recognition and support; it was the term retained as an alias for “meningioma” in Cushing’s 1922 Cavendish lecture in London.16,17

The Rise of America and American Neurosurgery

Harvey Cushing’s principal neurosurgical predecessor in the United States was William W. Keen (Fig. 7), considered by many to be America’s first brain surgeon.4 Keen spent 2 years in postgraduate study in Europe, first with one of the French founders of neurology, Guillaume Duchenne, and then in the laboratory of Rudolf Virchow in Berlin.4,10,13 Keen’s European training likely influenced his choice of the term “endothelioma” to describe these lesions.18,39 His most celebrated neurosurgical procedure was the resection of a convexity meningioma from a patient on December 15, 1887, in Philadelphia, Pennsylvania.4 This was the first brain tumor successfully removed in America, and the patient went on to live without recurrence of the tumor for more than 30 years.4 In spite of Keen’s known use of the term “endothelioma,” Cushing noted that regarding this convexity lesion extirpated by Keen in 1887, both the surgeon and his patient described the lesion as a “fibroma” and not necessarily as a “dural endothelioma”; “...We evidently were no further along at this time than were the French writers half a century before.”17

Cushing acknowledged the usefulness of Golgi’s term “endothelioma”; nonetheless, as Cushing nurtured a habit of closely scrutinizing the research of his peers and predecessors, he noted the limitation of this term: “…even this [term “dural endothelioma”] is now of questionable advantage, for it seems quite probable that, though attached to the dura, the tumours do not arise from this membrane proper, but rather from elements of the arachnoid which project into it; nor are they, in the parlance of some embryologists, tumours which, strictly speaking, actually originate from what are to be considered endothelial elements.”27,29

Harvey Cushing’s familiarity with 19th-century European scholarship on meningioma nomenclature and classification is evident both in the 1922 Cavendish Lecture, where he coined the enduring name for this tumor, and in his seminal 1938 monograph.16,17 Having lived in an era in which Europe was the professional finishing school for thousands of America’s elite medical graduates, Cushing’s early exposure to neurological surgery naturally included an apprenticeship in the Old World at the turn of the century.7 He observed and studied with British surgeons such as Victor Horsley, before moving on to France to observe, among other things, brain tumor removal and decompressive surgery for cranial trauma by Eugène-Louis Doyen.7 Cushing noted, at this time, that the state of surgery in France was superior to what he had observed in Great Britain; however, he was generally disappointed with these early examples of Western European neurosurgery.7 A later apprenticeship with Theodor Kocher in Germany proved somewhat more gratifying. Nevertheless, it became clear to Cushing that global leadership in medicine and surgery was shifting from Europe to America, and in neurosurgery, Harvey Cushing (Fig. 8) was the protagonist of this transition.7

Cushing was determined to eliminate the confusion caused by over a century of disagreement among pathologists concerning the histology and nomenclature of tumors that, from a surgical standpoint, appeared to share a common origin. He sought an uncomplicated term, “except insofar as it indicates that the growths in question arise in the leptomeninges.”2,16,17 The term would be applied to all tumors appearing to take their origin from the pachymeninges, regardless of the histological elements that predominate, the presence or absence of calvarial thickening, or other such varieties of what he considered to be a single neurosurgical entity.16,17 Discussing his ultimate choice of the term “meningioma,” Cushing clarifies his reasoning in the following comments on tumor designation:

Their cellular composition being in dispute, an “histogenic name” was likely to be misleading; a simple “place-name,” comparable to acoustic tumor, was inadequate since the tumors were widely distributed and took their origin from the leptomeninges almost anywhere; a “tissue-name” was therefore sought which, like osteoma, myoma and lipoma, would at least give an unmistakable connotation. Mesothelioma was discarded as requiring explanation, meningothelioma and leptomeningioma as being needlessly cumbersome. And since primary tumors indubitably of pachymeningeal origin and leptomeningeal tumors other than those under consideration are so rare as to cause little if any confusion, the simple and non-committal designation Meningioma as a catchword was thought to be suitable and all-embracing.17
growth is chronicled in Cushing’s text *Meningiomas*, and it set the stage for the modern scientific developments in meningioma research and surgery that we employ today.31

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