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Henry Duret (1849–1921): A Surgeon and Forgotten Neurologist

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Abstract

Henri Duret (1849–1921) was a surgeon whose training started in the laboratory of Jean-Martin Charcot and Alfred Vulpian at La Salpêtrière in 1874. Using injections of colored gelatine, Duret was the first to describe the distribution of supply arteries in the brainstem and then in the cortex. His descriptions correlated irrigated territories, infarcted zones and secondary neurological deficits. He focused his 1878 thesis on experimental studies of brain trauma and localized the origin of disturbances in autonomic function and vigilance to the brainstem. He linked these disturbances to microhemorrhages affecting the medulla and pons, which are now known as Duret hemorrhages. Over 40 years, he authored numerous publications on digestive and gynecological surgery and on teaching in these areas. In 1905, another of his innovative works was published, which covered brain tumours, their clinical manifestations, the pathophysiological consequences of intracranial hypertension and the corresponding surgical treatments. This little-known treatise is in fact a pioneering work in neurosurgery, published well before the more familiar works of Victor Horsley and Harvey Cushing.

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Henri Duret (1849–1921) was a surgeon who left us with works on digestive, gynecological and otorhinolaryngeal surgery and on breast surgery (the crests of Duret). However, his neurological research is much more original that he may be considered a forgotten pioneer of neurovascular pathology and neurosurgery. After a brief biography, we will present Duret's discoveries with a view to restoring their rightful place in the history of neurology [1].

A Brilliant University Career

Duret was born on 7 July, 1849 in Condé-sur-Noireau (Normandy, France). His father was a cotton yarn merchant. Duret began his studies at the medical school in Caen in 1867, continuing at the medical school in Paris in 1869. Ranking 23rd on the competitive exam for non-residents the same year, he decided to study surgery with Simon Duplay (1836–1924), a famous Parisian surgeon and editor of the *Archives générales de Médecine*, but the Franco-Prussian War erupted shortly thereafter. With his brief year of training, he nonetheless passed the exam to 'become a junior military physician at the Val de Grâce military hospital, and became a junior surgeon' two months later. He fought throughout the War of 1870 – from the siege of Sedan until the Tertre de Changé battle, close to Le Mans, which the French lost to the Prussians (12 January 1871) – in the army of General Alfred Chanzy (1823–1833). He then took care of the wounded round the clock for several weeks. Chanzy nominated him for the Legion of Honor when he was only 21, but he wasn't honored until 50 years later! Back from his army experience, Duret ranked 49th in the 1871 competitive exam for residents in the Paris hospitals. His classmates includ-

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ed Fulgence Raymond (1844–1910), Louis Landouzy (1845–1917) and Jules Voisin (1844–1920). He began his career in 1872 with Ulysse Trélat (1795–1879), head of a department for insane patients at La Salpêtrière Hospital. Trélat praised his student's 'exactitude and love of study'. His location allowed him to work in the laboratory connected to the department of Jean-Martin Charcot (1825–1893). When he published his first works, he indicated that he was a

> student in Professor Charcot's department, where we often witness the insufficiency of current knowledge on brain circulation in relation to the form, location and disposition of certain brain lesions, particularly haemorrhaging and softening [2].

He became an assistant for anatomy lectures on 30 April 1873 and continued his surgery training with Paul-Jules Tillaux (1834–1904) and Duplay, and also with Aristide Verneuil (1823–1895), for whom he became the *chef de clinique* (specialist registrar). Verneuil described his student as follows: 'Very hardworking, very well educated and extremely devoted to science. I am totally satisfied in all respects' [3]. He defended his thesis on 22 February 1878, before a committee including Alfred Vulpian (1826–1887), Jacques Grancher (1843–1907) and Samuel Pozzi (1846–1918) and presided by Verneuil. In his acknowledgments, he paid homage to Charcot, Verneuil and Vulpian, professors at the medical school 'who have inspired and guided us on the elevated path of science'. His thesis, focused on experimental studies of brain trauma, earned him the experimental physiology prize awarded by the Institut de France [4].

A Career as a Researcher and Surgery Professor in Lille

Although Duret ranked 1st on the competitive surgery exam for the Paris hospitals in 1882, he failed twice in the *agrégation* exam to become a professor. The 1880 jury composed of Jules Levrat (1850–1895) and Georges Bouilly (1893–1903) accorded available positions to Pierre Budin (1846–1907) and Paul Reclus (1847–1914) rather than to Duret [5], notwithstanding the fact that Duret had presented

> the first overview of the contraindications of surgical anaesthesia [...] Duret's work effectively summarises the enormous body of research on the action of anaesthetics on the organism, as well as the cases of death or severe accident.

This highly novel thesis, published as a book,

> reviewed 135 cases of death by chloroform; [Duret] aimed to determine in which cases death was caused by the anaesthetic agent alone, or by its use.

Duret also included each patient's clinical status [6, 7]. On his second attempt at the *agrégation* (30 June 1883), the jury chose Edouard Kirmisson (1848–1924), Victor Campenon (1846–1916) and Paul Segond (1851–1912) despite Duret's admirable presentation of the rare forms of inguinal hernias [8]. Some attribute his failure to his religious convictions during a time of anticlericalism [9, 10]. But Duret had worked with Charcot and Vulpian; he had published in their journals, notably *Les Archives de Physiologie normale et pathologique* starting in 1873, and submitted very regularly to *Le Progrès Médical* from 1873 to 1882. This publication was directed by Désiré-Magloire Bourneville (1840–1909), who made his anticlerical positions known and whom Duret nonetheless spoke of as 'his colleague and friend'. Realizing that a university career would be impossible for him in Paris, he relied on help from his brother, the abbey Joseph Duret, and joined the Catholic Medical School of Lille, founded in 1875. He did face some opposition from the Catholic hierarchy of northern France due to his work with the Salpêtrière school. He was initially named to the Chair of General Pathology and then to the Chair of Clinical Surgery, which grew in prestige from 1885 to 1911 due to the quality of Duret's teaching. An extraordinary capacity for work, a will of steel, perfect mastery in his operations and a remarkable feel for teaching earned him the admiration of his entourage, particularly his students:

> [Duret's] powerful activity drew in the youth around him like an irresistible cyclone […]. Everyone knew of his daring in the operating theatre; his sang-froid – not always calm – as proverbial and some of his operations will remain legendary [10].

Appointed the Dean of the Catholic Medical School of Lille three times (1890, 1899 and 1905), he created the Anatomical-Clinical Society of Lille for the students (modelled after the corresponding society in Paris), over which he presided from 1886 to 1905. He nonetheless did not neglect his duties at the Society of Medical Sciences of Lille, which he also presided over several times. To improve the care given by the Aid Society for the Military Wounded, Duret founded the Dispensary/School of the Red Cross of Lille in 1905. In collaboration with Jean Boulay (1838–1905), a professor of paleobotany at the Faculty of Sciences and also a priest, Duret founded the School of Anthropology, whose underlying goal was to defend Christianity [1, 9, 10]. Duret was elected a correspondent member of the French Academy of Medicine in 1900 and

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then as associate member in 1907. An active member of the Neurological Society of Paris, founded in 1899, he was also involved with the Biological Society throughout his long career, presenting his first work to members in 1873. He was a correspondent of the Royal Academy of Belgium, *doctor honoris causa* at the Université de Louvain and Commander of the Order of Saint Grégoire le Grand.

Duret retired in 1911 and could not be called up for service during World War I (1914–1918) because of his age. He nonetheless directed the auxiliary military hospitals 4 and 10, on the premises of the Catholic Medical School of Lille and in a nearby middle school. Duret 'deployed great energy to gradually slow the takeover of our auxiliary hospitals by German authorities and limit their hegemony to the utmost possible'. Duret was made a Knight of the Legion of Honour on 23 February 1921 for his military achievements. He died on 7 April 1921 after a slow, painful bout with cancer [10, 11]. Henri Claude (1869–1945), who held the Chair of mental illness and brain diseases at Sainte-Anne Hospital, delivered a eulogy to the Neurological Society on 5 May 1921, in which he recalled the

> formidable study undertaken during the war by this relentless worker, entitled: Traumatismes cranio-cérébraux. Formidable' is not excessive in qualifying such a work. Three enormous volumes of 1,500 pages have already been published.

The fourth was completed in 1922 by his colleagues in Lille: Jules-Alfred Voituriez (1858–1938) and Joseph Delépine (1877–1923). Claude went on to note:

> The preface of the first volume includes a brief summary of the work, followed by these moving lines: 'We thank heaven for being able to complete our project despite the horrors and suffering caused by a long war and a four-year occupation marked by persecution and cruelty'. As he notes, Duret pursued this work during the German occupation, and he explains that it was only after many appeals that the German authorities, in a show of 'humanity', decided against destroying the existing book! [12].

In early 1921, a few of his colleagues at the Catholic Medical School of Lille proposed Duret as a candidate for the Nobel Prize in Medicine or Physiology. His death put an end to their efforts. Whether coincidentally or consequently, the prize was not attributed that year [1, 9] (fig. 1).

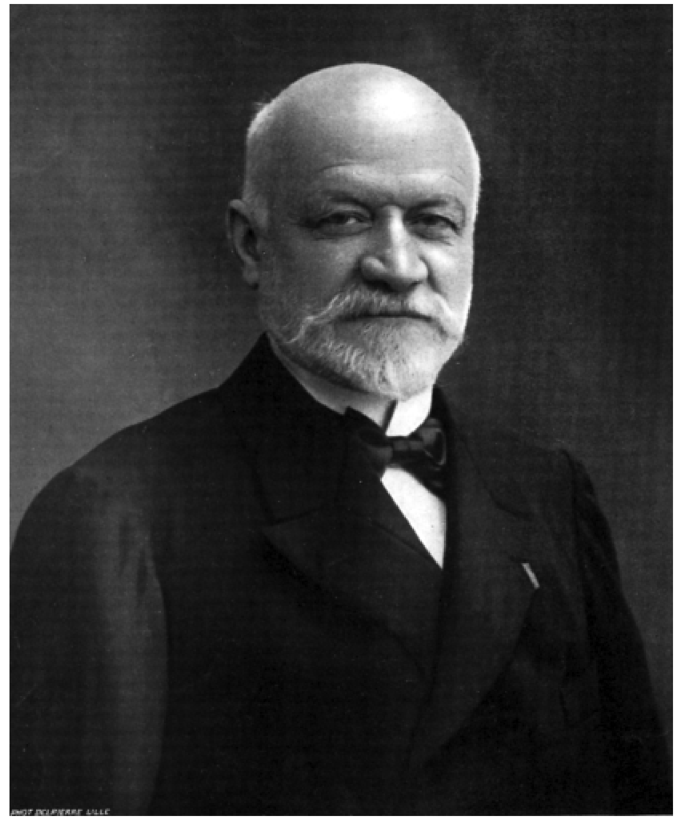

Fig. 1. Henry Duret (1849–1921). Open licence (http://www.biusante.parisdescartes.fr/histmed/image?CIPH0195). With kind permission of the BIU santé Paris.

On the Supply Arteries of the Brain

The thesis of Etienne Lancereaux (1829–1910), defended in 1862, is one of the first complete French-language reports of the pathophysiology of cardiovascular accidents; its title translates as 'Cerebral Thrombosis and Embolism Considered Principally with Regard to Brain Softening' [13]. In Germany in 1872, Julius Cohnheim (1839–1884), student of Rudolf Virchow (1821–1902), structured and named the modern concepts of embolic cerebral infarction, terminal arteries, and anastomoses (backup circulatory routes). However, none of these authors associate specific supply arteries with precise locations [14, 15].

It was Duret who, on 7 December 1872, presented the first study on 'the distribution of the arteries supplying the medulla oblongata' to the Biological Society. He wrote:

> The progress recently made in understanding medullary pathology calls for a more complete study of medullary circulation than what can be found in the treatises of descriptive anatomy. We have embarked on this study, under Charcot's direction, to fill this gap.

As Duret indicated,

> the supply arteries of the medulla, which we will call median arteries or arteries of the nuclei, have not been described [...]. The distribution of arterial blood in an organ as important as the medulla has not been left to chance; it is governed by laws.

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He went on to distinguish and describe with extreme precision the radicular arteries supplying the roots of nerves emerging from the medulla, arteries supplying brainstem nuclei, and other arteries supplying ‘other parts of the medulla’, thereby showing in a novel way

> the terminal disposition of the median arteries of the nuclei […]. This study of the distribution of medullary supply arteries provides a very satisfactory explanation for certain phenomena in medullary disease;

it also enabled Duret to compare his anatomical observations with those described by Adrien Proust (1834–1903) in his thesis defended in 1866, and with those of his colleague André Huret [16–18].

Duret’s descriptions were first published in *Le Mouvement Médical* (1873), then in *Le Progrès Médical* (1873) and finally, in greater detail in *Les Archives de Physiologie normale et pathologique*. He then enriched them in 1874:

> Our special aim is to describe the arteries supplying the brain […]. The anatomists who preceded us contented themselves with describing the origin and distribution of blood vessels in the brain in a general manner.

Duret proposed a precise and detailed study of the territorial distribution of each artery, using colored injections. Once again in a novel fashion, he distinguished ‘the arteries of the cerebral nuclei and the arteries of the gyri’. For the first time, he described ‘the branches supplying the striatum and the thalamus’. In particular, he distinguished between a branch

> that follows, along a certain length, the base of the lenticular nucleus at the limit of the external capsule, passing in front and inside toward the extraventricular basal ganglia where it divides into four or five terminal branches. This is the artery which, according to our studies at La Salpêtrière and the information provided by Charcot, is often the location of haemorrhaging in the striatum […]. This group of external arteries can be designated as the lenticulostriate arteries; the others – artères lenticulo-opiques [thalamogeniculate arteries] – pass behind, at the posterior extremity of the lenticular nucleus and terminate in the thalamus above it; they are only separated from the thalamus by the couronne de Reil [corona radiata] [19] (fig. 2).

Although Duret was unaware of it, shortly before his work was published, Otto Heubner (1843–1926), working in Germany in the anatomy laboratory of Ernst Leberecht Wagner (1829–1888), published in 1872 *On the topography of the nutritional zones of the individual brain arteries*, in which he described the vascularization of the anterior part of the caudate nucleus:

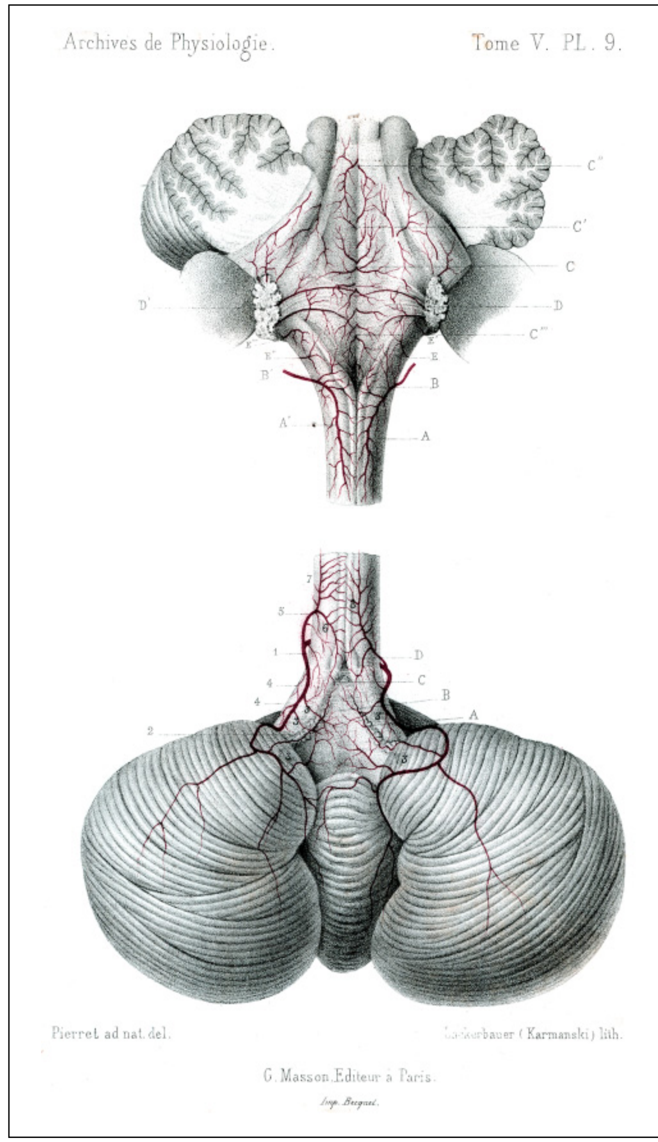

Fig. 2. Illustration 5, ‘Sur la distribution des artères nourricières du bulbe rachidien’. Archives de Physiologie normale et pathologique (1873). Private collection of the author.

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> From the base of the arteria cerebri anterior, which lies between the arteria cerebri media and the arteria communicans anterior, there constantly arises a very little artery, close to the latter that provides blood to the head of the corpus striatum.

This medial artery of the striatum is a branch of the A2 segment of the anterior cerebral artery. In 1909, Hamlet-Frederick Aitken (1872–1939), the medical illustrator at Massachusetts General Hospital, named it Heubner’s artery, which is important to identify in aneurysm surgery. According to Aitken, he did not find Duret’s *artères lenticulo-opiques* and therefore claimed that Heubner’s de-

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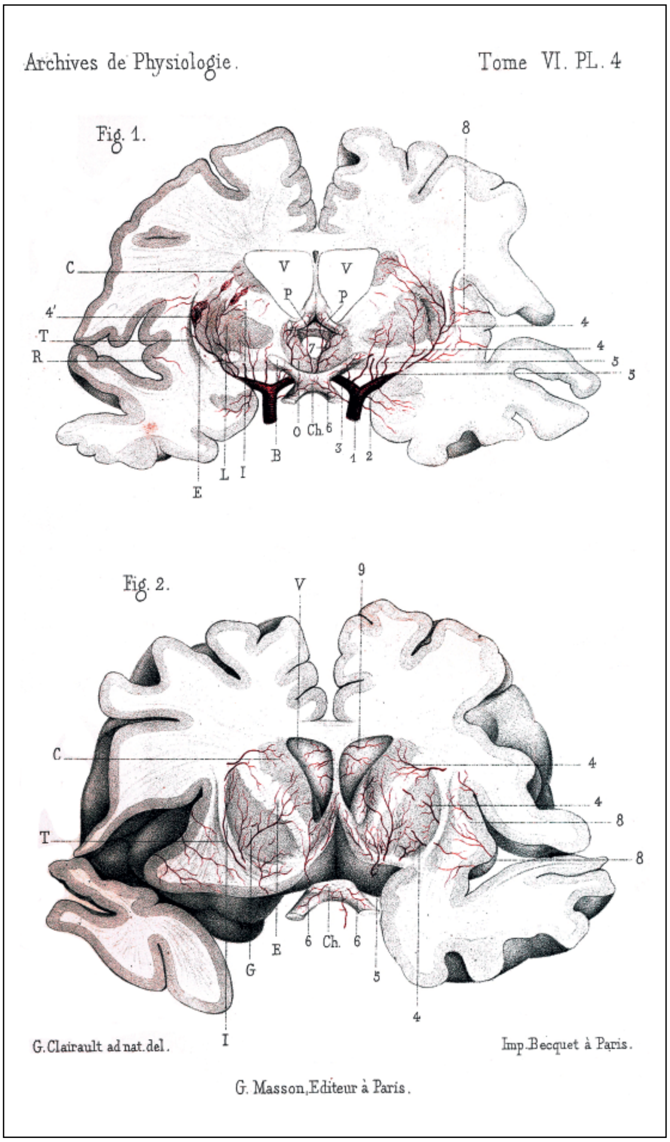

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Fig. 3. Illustration 4, 'Recherches anatomiques sur la circulation de l'encéphale'. Archives de Physiologie normale et pathologique (1874). Private collection of the author.

scription was the only valid one [20–23]. Despite the beginning of a controversy that has continued from Duret's death until now, these two publications earned Duret the Prix Ernest Godard (1826–1862), discerned by the Biological Society of Paris in 1874 [15, 24, 25] (fig. 3).

Duret's work gave rise to the theory of cerebrovascular accidents, whereby each cerebral infarct results from thrombosis in a single artery. This theory led to a multitude of studies, published at the beginning of the 20th century. In the following examples, the various authors all base their arguments on Duret's seminal publication – a good indication of the pre-eminence of his innovative research. In 1916, John Sebastian Bach Stopford (1888–1961), a professor of anatomy in Manchester, discussed and reviewed the study of brainstem vascularization by following in Duret's footsteps and providing commentary [26]. As for Alexander Kolisko (1857–1918) working in Vienna, in 1891 he contested the carotid origin of the anterior choroidal artery as described by Duret in 1874 [27, 28]. Charles Edward Beevor (1854–1908), often credited with the famous axiom of John Hughling-Jackson (1835–1911): 'The brain does not know muscles, only movements', spent seven years injecting hundreds of brains and thereby established the first arterial map of the encephalon. Refining Duret's technique, which consisted of injecting solid microparticles of colored gelatine of a single shade, Beevor simultaneously injected several arterial trunks, rather than one, and used a soluble gelatine in several shades. The words 'according to Duret' appear several times on each page of his descriptions [29, 30]. In 1925, Charles Foix (1882–1927) and Pierre Hillemand (1895–1979), who pioneered vascular neurology in France in the early 20th century, added details to and completed the description of brainstem and diencephalon circulation initiated by Duret 50 years earlier [31–34].

Duret once again revised all his descriptions in 1910:

> The distribution of cortical arteries, as established in our 1873–1874 thesis, was recognised as accurate by anatomists working in this area: Testut, Charpy, Lucas, Bissons, Looten, etc. Our descriptions also agree with those advanced around the same time by Heubner.

Duret defined the nomenclature for describing arteries, and also highlighted the fact that his work was at the origin of Charcot's ideas on cerebral localizations:

> These new acquisitions in the topography and function of various regions of the cerebral cortex add to the importance of our research on brain circulation, which Professor Charcot established, with his customary mastery, in his admirable lessons on the localisation of brain diseases (1876) [35].

The photographic illustrations included in this 1910 article are extremely clear and even rival contemporary arteriography images (fig. 4).

Cerebral Localizations

When Duret was still a young resident (1874 onward), he brought the innovative brain physiology research published in England by David Ferrier (1843–1928) to French readers by means of the translations he undertook for

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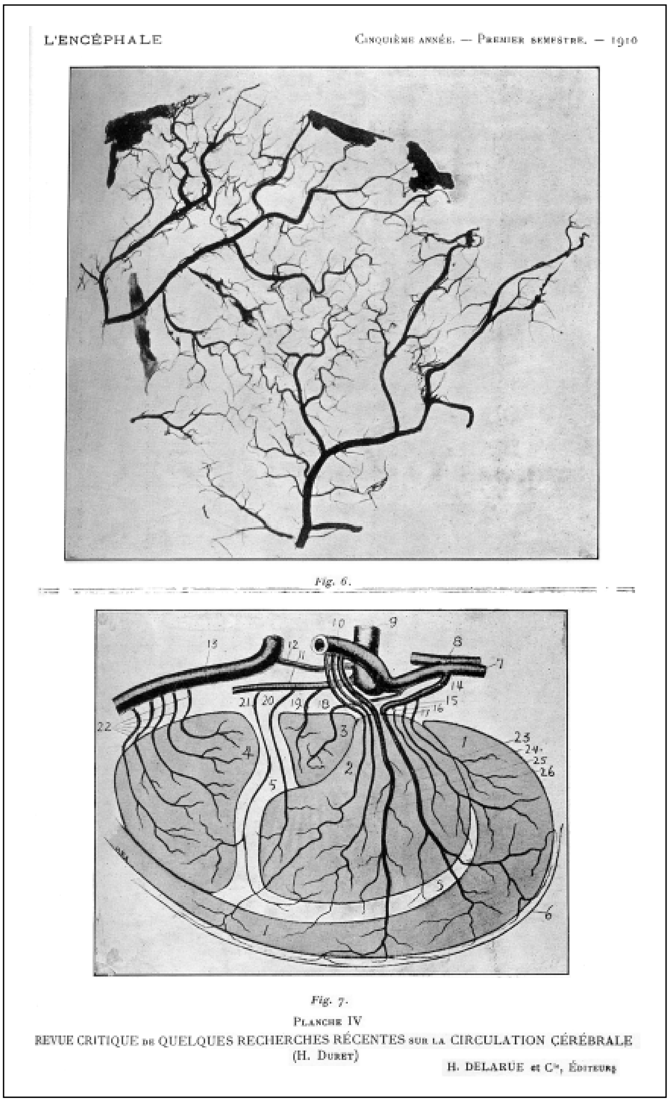

Fig. 4. Illustration 4, 'Revue critique de quelques recherches récentes sur la circulation cérébrale'. L'Encéphale (1910). Private collection of the author.

Le Progrès Médical [36]. The slender volume he produced was to serve as an introduction to a much more ambitious work to be published the following year. Together with Camille-Henri Carville (1828–1885), a student of Vulpian and assistant for his experimental pathology course, Duret presented, in 1875, 'a critical history of experimental research on the functions of the cerebral hemispheres' [37]. After describing localized ablation experiments on the cortex of rabbits and pigeons conducted by Pierre Flourens (1794–1867), Vulpian, and Ernest Onimus (1840–1915), then those involving localized 'interstitial' injections conducted by Henry Beaunis (1830–1921) and Hermann Nothnagel (1841–1905), Duret and Carville described all the recent advances made by using cortical stimulation involving non-destructive galvanic currents as developed by Gustav Fritsch (1838–1927) and Edouard Hitzig (1838–1907) in Germany, and faradic currents as developed by Ferrier in England. They put forth the following criticisms:

> It is striking that these eminent experimenters did not try to solidly ground their experimental methods. How could they not worry about their deductions being erroneous, given the methods they used? In faithfully following the processes described by these authors, can we be certain of localising the current? Does the current in fact act exclusively on the grey layer of the gyri and in circumscribed points of this grey layer?

Conducting these experiments themselves, they observed that

> during the electric excitation, the grey matter was involved in the movements produced, but the experiments showed that its integrity is not indispensible to produce localised movements using electric currents.

They confirmed that 'there is a physical conductibility of nerve fibres in the brain that has a certain direction, which is always the same' and makes use of white substance tracts.

> The research of Hitzig and Ferrier definitely points the way toward cerebral localisations, but the application of electrical current is a special excitation mode which, in our opinion, does not indicate with any certainty the actual significance of the movements they observed, or the actual role of the brain centres which they were first to describe. The electrodes applied at certain points of the brain surface determine special, localised movements, but nothing directly demonstrates that these movements are not produced by the remote action of the currents on the bulbospinal centres, nor that the localisation of these movements relates to the voluntary centres situated in the grey cortex [37].

Carville and Duret suspected the importance of the basal ganglia and mentioned the role of the caudate nucleus and the brainstem in the coordination of movements. In their conclusion, they put forth a cortical motor map, comparing their personal research with that of their colleague Jules Gromier, whose thesis compares human and monkey brains [38]. Their views seem obsolete today, as they are mostly hypothetical and lack demonstration. However, the pathophysiological explanations for the clinical observations at the end of their article, for which they acknowledge Charcot, still seem pertinent, comparing clinical deficits, relevant arterial territories and damaged structures. In recognition of their 'experimental and clinical research on the functions of the cerebral hemispheres', Carville and Duret, both still students, were awarded the 1874 Prix de l'Institut de France, an honor they shared with Ferrier, a professor in London.

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Brain Trauma

In 1878, Duret defended his thesis on experimental and clinical studies of brain trauma, explaining the reasons for his topic as follows:

> The exact signs that, during the life of a wounded patient, enable confidently identifying concussion, compression and contusion in the brain are not yet known [...]. Our main goal was to look for indications that might provide surgeons with information on the pathological state of nervous centres during the patient's life, as well as providing surgeons with justification for their operations and guiding them in their procedures.

Duret conducted his experimental neuropathology research in Vulpian's laboratory. He put forward a new concept:

> We will use the words 'cerebrospinal impact' to indicate that the sudden cessation or suppression of brain function subsequent to an impact to the skull is produced by means of the cerebrospinal fluid, which transmits the damaging action to regions of the brain capable of generating all the observed phenomena.

He opposed the notion of deleterious vibrations and the 'contre-coup' theories developed in the 17th and 18th centuries by François Pourfour du Petit (1664–1741), Giovanni Battista Morgagni (1681–1737), Antonio Valsalva (1666–1723), Jakob Winslow (1669–1760) and Dupré-de-Lisle [39, 40]. Duret believed that loss of consciousness and cardiorespiratory arrest were due to dysfunction in the brainstem, where he postulated that the control centers for not only the heart and breathing, but also consciousness, were located:

> [the brainstem] contains fibres that bring the intellectual centres into relation with the outer world, and the resulting relationships are, in our opinion, necessary for their function.

He also noted that

> the medulla oblongata is a centre of visceral life; [...] the medulla holds out the longest; it is the ultimum moriens among the nervous centres, to use the picturesque words of Charcot, our learned professor [4].

Following up on research conducted in Germany by Friedrich Pagenstecher on localized cerebral compressions, and in order to experimentally confirm his theory, Duret tested the effects of injecting water and wax inside the cranium of dogs and horses, in order to replicate the symptoms observed in humans after traumatic brain injury [41]. Then he experimented with hemispheric compression involving bone splinters or pieces of cork, thereby simulating the compressive effect of localized internal bleeding, especially in the meninges, in various localizations: vertex, at the base of the skull, and under the cerebellar tentorium. He deduced that trauma results in variations in the distribution of cerebrospinal fluid and thus in pressure in the spaces where the fluid circulates, such as the cerebral aqueduct. He saw this as the cause of the tissue lesions observed in the brainstem, the 'microscopic haemorrhages' which Theodor Kocher (1841–1917), a Swiss surgeon awarded the Nobel Prize in 1909, named 'Duret haemorrhages' (fig. 5). These hemorrhages can currently be detected by brain imaging and are recognized as being secondary to metabolic disturbances or trauma. In the latter case, they are associated with compression of the brainstem by the process of cerebral herniation, which Duret did not isolate. He saw these hemorrhages as demonstrating his theory concerning 'the action of a pressure increase in cerebrospinal fluid due to a sudden accumulation', which caused

Fig. 5. Illustration 5 of the Henry Duret's thesis (1874). Private collection of the author.

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a dotted line of haemorrhages on the floor of the medulla's thickness and around the central canal [...]; this is explained by the fact that at the time of impact, the fluid in the ventricles has an effect on the cerebral aqueduct, the fourth ventricle and, especially, the spine's central canal.

His description of diffuse tissue bleeding in the brainstem is accurate, but the pathophysiological mechanism he postulated, and believed his experiments proved in animals, is erroneous [42, 43].

Duret is, however, correct in his description of the effect of increased intracranial pressure on arterial circulation: 'As a result of our experiments, blood flow stops in the arteries of the brain, when the impact occurs and in the minutes that follow'. He thereby confirmed the observations of Ernst von Leyden (1832–1910) in 1866 [44]. Duret also noted that before the final phase of intracranial circulatory arrest, an increase in the systemic arterial blood pressure occurs, a phenomenon known as the 'Cushing reflex' even though Harvey Cushing (1869–1939) wouldn't describe this phenomenon until 1901 (when he described herniation), 24 years after Duret [45, 46]. The next part of Duret's thesis reviewed the differences related to the location of impact, and postulated mechanisms for direct and indirect impacts. Duret clearly formulated the consequences of intracranial hypertension:

The skull is a closed cavity. If you put it in contact with a source of pressure, you will clearly disturb blood flow, as soon as the pressure exceeds arterial blood pressure.

He deduced that blood flow and the sensitivity of the meninges are impaired, which, along with damage to the medulla structures, explains the autonomic disturbances and abnormal states of arousal in patients with brain trauma. Duret never described subfacial (temporal) herniation or tonsillar herniation, but he did mention the surgical necessity of opening the cranium to diminish nervous system compression [47].

Brain Tumours

At the beginning of the 20th century, the only book in French dedicated exclusively to brain tumours was that of Maurice Auvray (1868–1945), which was published in 1896. In 1894, Edouard Brissaud (1852–1909) wrote a chapter on the subject in the medical treatise known as 'Traité de Charcot, Bouchard, Brissaud'; and Fulgence Raymond (1844–1910) taught 'lessons' on brain tumours at La Salpêtrière, which were published in 1898. We should also mention the monumental and visionary treatise on nervous system surgery, *Chirurgie opératoire du système nerveux*, which Antony Chipault (1866–1920) published in 1894; however, this book focuses more extensively on surgery to treat ORL infections rather than brain tumours per se.

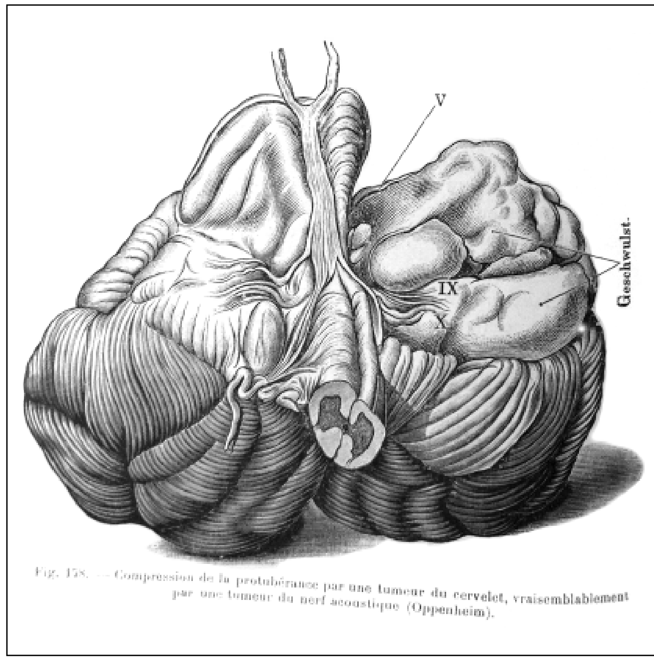

Fig. 6. Illustration 10, Brainstem compression by a cerebellar tumor in 'Les tumeurs de l'encéphale: manifestations et chirurgie' (1905). Private collection of the author.

It was in Great Britain that neurosurgery originated when William Macewen (1848–1924) published a report in 1879 on the exeresis of a meningioma [48]. In 1885, Alexander Hughes Bennett (1848–1901) localized a tumor on which Rickman Godlee (1849–1925) successfully performed an exeresis [49, 50]. Victor Horsley (1857–1916) was the first to operate on epileptics. In 1887, he published a series of ten tumor exereses, describing in great detail his techniques [51]. After focusing on cerebral localizations and intracranial hypertension, Duret logically turned his attention toward brain tumours. Although a surgeon, Duret himself performed very few surgeries on the nervous system. His book *Les tumeurs de l'encéphale, manifestations et chirurgie* was published in 1905, building on the report he had presented in 1903 at the French Surgery Conference. This literature review, international in scope, enabled him to report on 400 observations of intracranial tumours [52]. The resulting work, a monumental 835 pages and 297 figures, is divided into four parts: general manifestations, localized manifestations, diagnosis and surgery (fig. 6). Duret attempted to respond to the concerns of surgeons:

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> The problem to resolve, for surgeons, is threefold. Is there a tumour? Where is it located? What type of tumour is it? These are the three preliminary questions that the surgeon must answer.

Each clinical sign is studied, and extremely precise semiological details are presented, concerning headache, vomiting, dizziness, convulsions, 'cerebral torpor', etc. He insisted on the value of papilloedema, describing the German-language notion of 'Stauungspapille' and the English-language notion of 'choked disk'. He also covered the history of research on this symptom and illustrated it macro- and microscopically. In addition, Duret wrote of the difficulty of identifying tumours which had been latent a long time, or which resulted in psychiatric-like manifestations. For each clinical sign and also for the correlation between clinical signs and localizations, Duret proposed a pathophysiological and histopathological explanation, citing a multitude of foreign authors such as Albert Adamkiewicz (1850–1921), Ernst von Bergmann (1836–1907), Ludwig Neumayer (1868–1934), Carl Wernicke (1848–1905), etc. And he did not fail to mention the contributions of Pierre Marie (1853–1940) and Joseph Babinski (1857–1932) to the description of tonsillar herniation in cases of intracranial hypertension. Duret underscored the importance of seminal works by Henri Parinaud (1844–1905) on ocular paralysis, by Edouard Brissaud (1852–1909) on 'cerebral localisation and facial movements', by Fulgence Raymond (1844–1910) on the tumors at the base of the skull, and by Babinski on cerebellar syndrome. And he described the possibility of metabolic disturbances in cases of hypothalamic-pituitary tumours, subsequent to publications by Pierre Marie and Georges Marinesco (1863–1938).

While it is somewhat surprising to find a chapter on percussion of the skull bones, this bears witness to the difficulty involved in localizing brain tumours. Differential diagnosis must take into account tuberculosis, both meningeal tuberculosis and tuberculoma; infectious or parasitic abscesses; encephalitis; hydroencephalus; syphilis; epilepsy; uraemia; hysteria; etc. Duret recommended lumbar puncture and illustrated his book only with two skull radiographs, both blurry and not very helpful.

Finally, Duret argued in favor of brain surgery: 'Tumour surgery is complex and difficult but will soon reach a stage where the success rate is high'. This stood in opposition to colleagues such as Ferrier, who declared that surgery on brain tumours was a disappointing affair [53]. Duret acknowledged his debt to Ludwig Bruns (1858–1916) [54], and to Moses Allen Starr (1854–1932), whom he met at La Salpêtrière and who authored one of the first treatises on brain surgery [55]. Duret also saluted Just Lucas-Championnière (1843–1913), who invented the trephine [56] and gave special mention to Chipault and Horsley for their surgical daring and the instruments they invented to perform craniectomies. Duret's book described instruments invented throughout the world, covering both design and usage techniques. He concluded with statistics from the 400 operations studied. It is surprising that this monumental work is not better known, that it was never cited by Cushing, for example, despite the wealth of collected data, and the quality and quantity of figures.

Conclusion

In 1921, Albert Besson (1896–1965) paid homage to his teacher for 'this stunning professorial career and nearly forty years of prodigious activity'. This, however, did not prevent a pioneer from being unfairly forgotten [11]. As Henri Claude explained in the eulogy he read before the Academy of Medicine:

> Duret perhaps lived too isolated a life, absorbed as he was by his teaching and research, which meant he did not enjoy all the recognition that his eminence should have ensured him and that opinion bestows too easily on more clamorous natures. He will be remembered as a person of high moral value, and his work will endure because it is the work of a master [12].

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