

## Edward Flatau (1868–1932) — world-leading pioneer of neurology and neurosurgery

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### ABSTRACT

Polish neurology and neurosurgery owe a very great deal to Edward Flatau. He was a pioneer of these disciplines in Poland whose influence extends worldwide, and we recently celebrated the 150<sup>th</sup> anniversary of his birth. Edward Flatau's grandson, an outstanding physicist who has been living in San Diego in the USA for many years, has published a book 'Edward Flatau and his comet: beginnings of Polish neurology'. Its promotion took place in the Flatau hometown of Plock in Poland.

In 1894, Edward Flatau published his notable work: 'Atlas of the human brain and the trajectory of fibres', the result of arduous work on brain sections and images that were captured with an especially designed camera. These photographs caused a publishing sensation at the end of the 19th century. The atlas was published in German and almost immediately translated into Polish, Russian, French and English. The most distinguished work of Edward Flatau was his great 1912 study of migraine headaches entitled 'Migraine', which has still not become out-of-date and is regularly quoted in international literature today.

**Key words:** atlas of human brain, migraine, Flatau's law, great pioneer of neurology and neurosurgery

Polish neurology and neurosurgery owe a great deal to Edward Flatau (Fig 1.). He was a pioneer of those disciplines in Poland.

Edward Flatau was born the son of Louis Flatau and Anna (Heyman) Flatau on 27 December 1868 in Plock and was raised in a Jewish merchant family living on Kolegialna Street (Fig. 2). Edward had three brothers: Roman (born 1867), Julian (1870), and Henry (1872), and a sister Helena (1875). His father Louis (or Ludwik) Flatau run the trading company 'Banking House' until his death in 1890 when the company was taken over by his wife Anna with the help of their sons. She also opened the Ludwik Flatau Nursing Home which was designed for disabled elderly Jews. All the Flatau sons attended the Małachowianka boys' gymnasium in Plock, which was known for very high educational standards. Edward graduated with a silver medal in 1886. At that point Flatau left Plock, but in City Books he remained a citizen until 25 December 1908. The Flatau family house survives today and is used as a register office.



**Figure 1.** Portrait of Edward Flatau made in 1928 in Warsaw. Photo by A. Gurtler. From family archive.

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**Figure 2.** Edward Flatau's family house in Plock, Poland. Currently a register office. Source: Author's own archives

The city of Plock was thus very important to Edward Flatau, being the place where he spent the formative years of his life. His relatives and grandparents are buried in the Jewish Cemetery in Plock. In the late 19<sup>th</sup> century, the city was multicultural, open to different nationalities (Poles, Jews, Germans, Russians) and religions (Catholics, Jews, Old Catholic Mariavite Church believers, Evangelicals, Orthodox). In 1886 Edward left for medical studies at the Imperial University in Moscow's Medical Department. A few years later in 1892 he gained his medical diploma from the University of Moscow. After another four years he published his doctoral dissertation there [1].

At this point of his education the biggest influences on his personal development were two Russian scientists: the neuropathologist Prof. Aleksiej Kożewnikow (1836–1902) – author of many academic works on neurology (for example concerning aphasia, epilepsy) and Prof. Siergiej Korsakow (1854–1900) – an inventor of innovative methods of treatment and nursing patients suffering from mental disorders. Korsakow also wrote about oblivion and hallucination syndrome that had arisen due to organic changes in the brain on the basis of post-alcoholic alteration [2].

Flatau's next move, just a year after graduation, was to travel to Berlin which at this time was an incredibly buoyant academic and scientific centre, especially in the discipline of medicine. At the turn of the 20th century, it was in Berlin where started the process of 'extracting' Neurology from Internal Medicine and Psychiatry. At meetings of the Berlin Psychiatry and Neurological Diseases Society many different views were exchanged. In Berlin one could observe at this time intensive co-operation between neuroanatomists, neuropathologists, neurosurgeons and neurologists. Flatau went there to deepen his knowledge of such areas as anatomy, histology and the pathology of histology of the central nervous system. He met there some of the most famous German scientists, including anatomist and histologist Prof. Wilhelm Waldeyer and Prof.

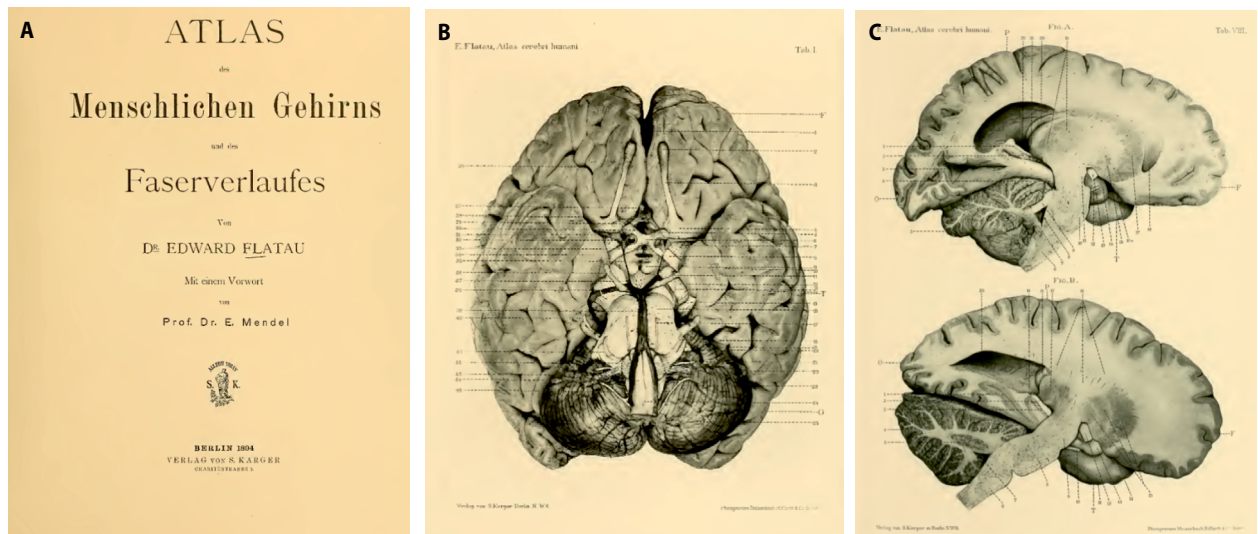
Ernst Leyden. Flatau started an effective co-operation with Prof. Alfred Goldscheider, Prof. Louis Jacobsohn and Prof. Emanuel Mendel, Ernst Remak, Hugo Liepmann, and Herman Oppenheim. He found a friend and science-partner in Louis Jacobsohn. Firstly, they worked together in Mendel's laboratory, and then they continued their co-operation at Waldeyer's laboratory [3].

The progressive movement mentioned above was mainly created outside of the Universities. Orthodox professors preferred the old divisions. What is more, those who worked on neurology at the perimeters of Universities were mainly Jewish. Because of anti-Semitic regulations and limitations they had little chance of academic careers, so they founded private ambulatory clinics and laboratories, and taught as unofficial and unpaid lecturers in Universities [4].

In 1894, Edward Flatau published his notable work: 'Atlas of the human brain and the trajectory of fibres', the result of arduous work on brain sections and images that were captured with an especially designed camera (Fig. 3). These photographs caused a publishing sensation at the end of the 19th century. The atlas was published in German, and almost immediately translated into Polish, Russian, French and English. The book was the world's first photographic neuroanatomical atlas. The introduction was written by Mendel himself, while Sigmund Freud wrote an enthusiastic review of the atlas in the Viennese journal 'Internationalem Klinischen Rundschau' [5].

The work instantly gained international renown. It was an enormously important contribution by a Polish scientist to global neurology, yet even so it was just the beginning of his international achievements.

He was carrying out very broad research with a physiologist – Prof. J. Gad. These were experiments conducted on dogs concerning, among other things, the intersection of transverse myelitis, and electrical stimulation on dogs' intersected transverse myelitis. On the basis of this research, he formulated a law involving long trails in the core which always progress



**Figure 3.** A, B, C – *Atlas of the human brain and the trajectory of fibres*, E. Flatau, 1894, early 20<sup>th</sup> century

circumferentially and which is now called Flatau's law. This thesis was his doctoral dissertation for the Imperial Moscow University and is regarded as one of the most important in the whole of neurology in the 19<sup>th</sup> and 20<sup>th</sup> centuries [6].

Between 1896 and 1899, Edward Flatau conducted experiments with Alfred Goldscheider, head of the first Internal Academic Clinic in Berlin. These experiments concerned the spreading of an injected solution of dye into the grey matter core, carried out in order to explore the issue of haematomyelia and the work on a tighter placing system representing a singular group of muscles in the core. Meanwhile, both men were also exploring the pathology of nerve cells by acting upon them with many different detrimental factors. They published as a joint work a monograph regarding the anatomy and pathology of nerve cells. Alongside this work, Flatau was still working with Louis Jacobsohn by publishing a textbook about anatomy and a comparative anatomy of mammals (1899). A few years later in 1904 they published another textbook about the pathological anatomy of the nervous system [7].

By 1899, Flatau was known throughout Europe. He was offered the post of chair of the Department of Neurology in Buenos Aires, Argentina. He declined because what he wanted the most was to develop neurology in Poland. That same year he came back to Warsaw. Unfortunately, he was not given an engagement. All he was offered was a position of neurological consultant on internal departments with Theodor Dunn and Wladyslaw Janowiak. The other consultant position was given to him in the surgical department by Bronislaw Sawicki and Wladyslaw Krajewski in the Warsaw Hospital of Baby Jesus. In 1900, with Sawicki, he published a pioneering thesis concerning the surgery of circumferential nerves. This opened new possibilities of surgical treatment involving circumferential nerves and cerebral palsy. In 1904, Flatau became head of the Neurological Department in Starozakonny Hospital at Czystem in Warsaw [8] (Fig. 4).



**Figure 4.** Starozakonny Hospital, Czystem, Warsaw, early 20<sup>th</sup> century

Flatau, Krajewski and Sawicki were the first to perform surgery on a tumour on the spinal cord, in December 1899. He was also the first propagator of the use of radiotherapy in nervous system diseases (e.g. tumours of the spinal cord and brain, migraine, multiple sclerosis, inflammations) [9].

Thus Flatau is said to have started the 'School of Neurology' – the first non-academic school of neurology in Poland and in fact the first anywhere in the world. Flatau is acknowledged as its founder and the first scholar neurologist. Many neurologists did not have their own departments and attended his weekly ward-rounds opened up for observation. Flatau gave them also lessons in practical neurology [10].

In his own apartment, he organised a microscopic lab and in 1913 he arranged a new lab near to the Psychological Association at Aleje Jerozolimskie 85. Finally, he created a Neurobiological Lab in the Institute of Marcei Nencki, which he supervised until the end of his life. In his lab he was exploring microscopic histologic sections, and he was conducting

experiments concerning the functioning of circumferential nerves, multiple sclerosis, myasthenia gravis, tumours of the central nervous system, as well as inflammatory diseases – particularly tuberculosis – and many other medical issues. He was constantly collecting literature, and discussing with his associates. The results of his experimental works he collected in two volumes – the first was published in 1916 and the second in 1919 [11].

Dr Flatau was so popular that doctors from all over Poland were applying for positions in his lab. One can formulate the thesis that Edward Flatau was fulfilling an educational mission similar to the one that Józef Babiński was completing in Paris.

Flatau's reputation preceded him, according to his colleague Eufemiusz Herman, and hundreds of patients travelled from all over Russian Tsarist Poland to visit his private practice. His daily routine was set. He started at 9am in the laboratory to prepare and examine histological specimens while imparting his knowledge and thoughts to his students by discussing in detail the latest medical reports. He finished in the laboratory at 11am and left by carriage, stopping en route at the café, for his hospital ward round, and then he consulted with his private patients. For example, in 'A Clinical Lesson at the Salpêtrière' on Mondays, under the guidance of Edward Flatau, the celebrated scientist held demonstrations and practical neurology lessons. Monday ward rounds were particularly concerned with discussing symptoms and eliciting signs at the bedside of each patient, with specialists in neurology, psychiatry and internal medicine gathered from across Warsaw [12, 13].

He was an outstanding science researcher, a talented clinician, an excellent educator and organiser, an extremely hardworking human being, and an enthusiast for neurology and neurosurgery. Flatau investigated tuberculosis of meninges, inflammatory disorders of the nervous system, and nervous system diseases of the brain and spinal cord. He designed a method of clinical examination of permeability of meninges for different substances, for example medicines and pigments – so called chromoneuroscopy. In the therapy of tumours of brains and spinal cords, he advised the concurrent use of operating treatment with receiving X-ray or radium applications. Flatau was one of the first proponents of such treatment. He was regularly applying lumbal puncture even when most doctors were fearful about such measures. He was offering surgical treatment for many neurological diseases. Edward Flatau is the explorer of: napping-midriatic symptom, erection symptom in tuberculosis of meninges, infrapatellar channel symptom, chin-cornea symptom in SM, and widespread encephalitis [14].

He was especially interested in brain tumours and when he experienced his own first symptoms he immediately recognised this illness in himself. From the accounts left by neurologists, specifically Eufemiusz Herman and Gustaw Bychowski, we know that when Flatau had the initial symptoms of a brain tumour, he recognised it himself, made a close observation, and followed its progression and continuance. Flatau stated

that his tumour was inoperable. He created a close clinical spectrum of glioma. He was describing his symptoms in detail and he maintained a journal of his disease probably right up to the moment of his death. This, his last medical piece of work, was destroyed during World War II.

The term dystonia musculorum deformans was coined by the German neurologist Hermann Oppenheim in 1911. At the same time, Edward Flatau and Wladyslaw Sterling described the same condition observed in two Polish Jews under the name of 'progressive torsion spasm', and they criticised Oppenheim. In Flatau and Sterling's opinion, fluctuating muscle tone was not necessarily characteristic of the disorder, and the term 'musculorum' incorrectly implied that the involuntary movement was due to a muscle disorder, although not all patients became deformed. Flatau proposed 'progressive torsion spasm' to be a basal ganglia disease.

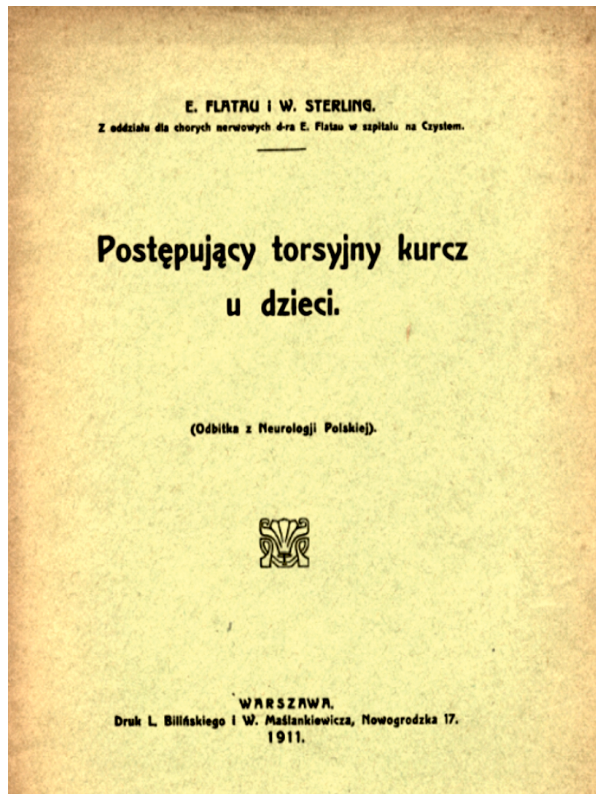
Oppenheim stated that: "*the clonic jerks do indeed belong to the clinical picture,*" "*the hypotonia is a major element of the symptomatology,*" and "*the tonic cramps are very predominantly connected with the function of standing and walking.*" He proposed naming the disease '*dystonia*' (i.e. abnormal muscle tone) or '*dysbasia*' (i.e. abnormal base while standing or walking) [15].

Flatau and Sterling's reasoning led them to dispute this terminology. They stated: "*With the name suggested by Oppenheim (Dysbasia lordotica progressiva and Dystonia musculorum deformans), we cannot be satisfied for the reason that in some, such as our two patients, the disease is as strong in the upper as in the lower extremities, and dysbasia is not the principal symptom. We have also shown that there is no hypotonia in our patients, and we also believe that the word 'deformans' connotes something stable, which is not true in the case of the essentially mobile spasm*" [16].

They highlighted the genetic nature of the disorder and suggested the term 'progressive torsion spasm'. They also rejected the hysterical basis of the disease and described a high intellect in both patients.

Flatau and Sterling observed that patients were intellectually and emotionally capable, concluding that this was a hereditary disease. At this time the prevailing concept was that of T. H. Ziehen and Oppenheim, which is presented above, i.e. dystonia as a muscle disease with a psychic basis. The approach of Flatau and Sterling was completely different, and it has turned out to be correct. It must be underlined that the thesis construed by Ziehen and Oppenheim was the orthodoxy at the time, but in the end the concept of Flatau and Sterling was found to be correct and medically relevant [17].

Perhaps the most distinguished work of all of Edward Flatau was his great study regarding migraine headaches entitled 'Migraine' published in 1912. This has not become out-of-date even now and is regularly quoted in international literature. It was the first Polish textbook concerning the issue of migraine. The book was based on auto-observations

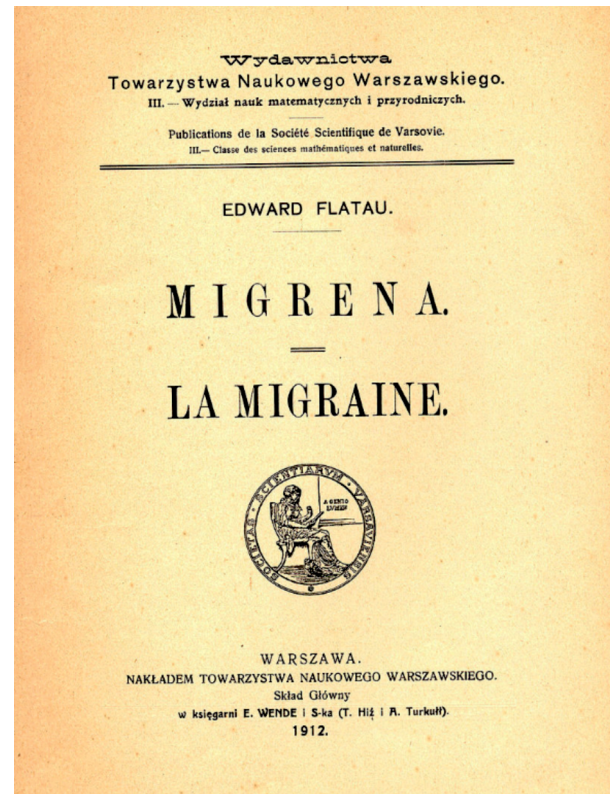


**Figure 5.** Flatau and Sterling's work proposing 'progressive torsion spasm'

(because Flatau was experiencing migraine himself) and on 500 cases of his patients, which is a significant number even nowadays. This book is 300 pages long, and paints a very extensive clinical spectrum regarding the pathophysiological mechanisms of this particular disease. The seventh chapter of the book is devoted to migraine treatment. Flatau gave his recommendations about diet, a healthy lifestyle, and the need to avoid tobacco. He also showed a large list of pharmacological treatments which he tested on his patients and himself. Among those medicines are aspirin, codeine, and ergot. All of those are still used today. More controversially, Flatau describes the use of arsenic in migraine treatment, but he explicitly states that he did not observe any of the expected results even after regular ingestion [18].

In 1920, the University School in Warsaw was founded. Edward Flatau was not appointed the Head of the Neurological Department, even despite a direct recommendation from Jozef Babinski himself, the post being eventually given to Kazimierz Orzechowski [19].

Edward Flatau was always very devoted to progressive social activity. He created a neurological-psychiatric section in the Warsaw Physician Society and then the Warsaw Neurological Society, clinical section to the Public Medicine Society. He also created a progressive social-physician magazine, the 'Warsaw Physician Magazine', a neurological magazine 'Polish



**Figure 6.** *Migraine*, E. Flatau, 1912

Neurology', and the 'Quarterly of the Clinical Hospital at Czystem' [20].

After many years of co-operation with Emil Redlich in Vienna on multiple sclerosis, Flatau described the first cases of an epidemic of disseminated encephalomyelitis in 1927. Due to his masterful descriptions, French authors named this disease Redlich-Flatau disease. What is more, Flatau suggested that that it must be caused by a virus, something which was confirmed after his death by the respected Soviet neurologist Prof. Margulis [21].

The year after Flatau's death in 1932, the Convention of Scientists and Physicians in Warsaw created the Polish Neurological Society – as expressly requested by Edward Flatau. Its first chairman was Kazimierz Orzechowski, professor and supervisor of Warsaw Neurological Clinic.

Edward Flatau was the author of approximately 80 articles which show a great amount of exploratory science, plus innumerable research accomplishments and observations, which together brought him into international prominence.

In contemporary neurology, there are still several eponyms connected with Edward Flatau:

**Flatau's law** — A law concerning the eccentric position of the long spinal tracts, this law states that the greater the length of the fibres in the spinal cord, the closer they are situated to the periphery

**Flatau's sign** — A sign in meningitis. Flatau's sign presents as mydriasis (pupillary constriction) in response to neck flexion (assisted if necessary) in meningitis. Aetiology is unclear, but stretching of medulla and involvement of meningeal sheet of spinal nerve radices (pachymeninges) might be possible causes

**Flatau-Sterling syndrome** — Dystonia as 'progressive torsion spasm'

**Redlich-Flatau disease** — Shortly after Emil Redlich in Vienna, Flatau described in detail the clinical spectrum of epidemic-disseminated encephalomyelitis

**Flatau-Schilder disease** — In 1925, he described encephaloleucopathia scleroticans progressiva or encephalitis periaxialis diffusa (Schilder or Flatau-Schilder disease) [22].

The accomplishments and contributions of Edward Flatau in the fields of diagnostics, neurology and the anatomy of the nervous system are enormous. They still to this day carry great practical and theoretical significance, which we would do well to remember.

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