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Wroclaw as the Leading Neurolinguistics Center  
at the Turn of the 19th and 20th Centuries

Abstract

Pre-war Wroclaw was the prominent neurolinguistics center at the turn of the 19th and 20th centuries. The achievements of Wernicke, his students and associates are well known worldwide; however, the contemporary context of the University of Wroclaw, archival details and evidence of memory, that is presented in this article, is crucial. The study on the human brain and its connection to languages can be found in the research conducted by German scientists such as professor doctor Carl Wernicke (1848–1905) and professor doctor Alois Alzheimer (1864–1915) before the Second World War at Breslau Universität, today known as the University of Wrocław. Many publications and papers published in pre-war Wrocław\(^1\) (Breslau) indicate that major discoveries took place in Wrocław. The main objective of this research is to present, on the basis of archival documents, the group of neurologists and psychiatrists, the students of Carl Wernicke, who lived in the city and conducted their research on the brain. After Wernicke's death, all of the students and assistants presented in the article took leading positions worldwide in conducting research on aphasia. Most of them continued Wernicke’s approach, while holding prominent university positions. The presented research may encourage other authors to carry out a comprehensive, in-depth analysis of the achievements of the Wrocław School of Neurolinguistics.

Keywords: neurolinguistics, Breslau, linguistics, language disorders, Carl Wernicke

Introduction

This paper aims to present one of the aspects of the history of linguistics, which is the origin of Breslau's neurolinguistics. Researchers who lived in Breslau, such as Alois Alzheimer or Carl Wernicke, are well-known globally for their achievements. Their successful discoveries (presented in more detail in the third part of this article) to these days have been valid and used to diagnose particular language and brain disorders, such as Alzheimer's disease or Wernicke's aphasia. The study focuses on the researchers who conducted their analysis on language and brain in pre-war Breslau and, as a result, contributed to the de-

\(^{1}\) In this article, the term ‘Wroclaw’ is used when describing the period after World War II.
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development of medical institutions. The first part of this paper covers an overview of neurolinguistics, with the emphasis on psycholinguistics as one of the disciplines from which neurolinguistics has emerged. The second part presents major academic institutions such as the University of Wrocław, Charité Institute, Berlin and Frankfurt University where significant discoveries on language and brain took place. The last section describes academic neurolinguistics in Breslau. Here, the life of the main figures such as Heinrich Neumann [1814–1884], Carl Wernicke [1848–1905], Karl Heilbronner [1869–1914], Otfrid Foerster [1873–1941], Karl Bonhoeffer [1868–1948], Alois Alzheimer [1864–1915], Hugo Liepmann [1863–1927], Ernst Storch [1866–1916] and Kurt Goldstein [1878–1965] is presented, including selected archival materials obtained from the scientific institutions described in the second part. Location of archival materials\(^2\) is described which can help researchers involved in the study to find the materials of their interest.

1. Neurolinguistics – an overview

Neurolinguistics is a science on the border of linguistics, psychology, and neurology, studying nervous mechanisms within the human brain that control linguistic activity and changes that develop in speech due to local disturbances in the brain’s work. Neurolinguistics tries to construct a relationship between speech and aspects of brain functioning based on various disorders such as aphasia, stuttering, or dysarthria (Zubicaray and Schiller 2019: 9). Neurolinguistics covers approximately the same range of topics as psycholinguistics does, i.e. all aspects of language processing, but it is considered from the different scientific perspectives and methodologies. Due to its multidisciplinary nature, neurolinguistics draws its methodology and theory from many other scientific fields such as neurobiology (neuroscience), linguistics, cognitive science, neuropsychology and computer science. Much of the neurolinguistic analysis is based on psycholinguistics and general linguistics, focusing on examining mechanisms that enable the brain to carry out the processes that psycholinguists and general linguists believe are essential to creating and understanding statements (Mistrík, 1993: 296). Neurolinguists study physiological mechanisms by which the brain processes language-related information, as well as linguistic and psycholinguistic theories using aphasia, neuroimaging, electrophysiology and computer simulations.

It is worth noting that neurolinguistics emerged from psycholinguists’ interest in the processes taking place in the brain when using language. The research on language learning processes is used by glottodidactics\(^3\) and methodology of foreign language learning. Psycholinguistics is a field of science on the border of psychology and linguistics dealing with the psychological basis of language functioning, i.e., how language is acquired, processed, and used by the human mind (Mistrik 1993: 358). The essential psycholinguists were Jean Piaget [1896–1980], Burrhus Frederic Skinner [1904–1990] (whose behavioral theory revolutionized the perceptions of language acquisition and the perception of the phases of speech acquisition), and nowadays Noam Chomsky (Levelt 2013). As part of his arguments, Chomsky reintroduced the idea of mental representations back to the study of language. He also drew an important

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\(^2\) Pictures of original texts were taken by Aneta Daniel, 20.06.2019.

\(^3\) Glottodidactics is a method that prepares very young children to learn to read and write. It allows developing these skills through creative didactic games. What is Glottodidactics? Retrieved from: https://academyinternational.pl/en/what-is-glot todidactics [date of access: 10.11.2020].
distinction between the knowledge that people had about language, called “competence” and the use of language, “performance” similar to the distinction of langue and the parole drawn by Ferdinand de Saussure roughly 60 years earlier (Cowles 2011: 16). Chomsky’s influence on modern linguistics and psycholinguistics is profound, and his focus on competence (as opposed to performance) has drawn linguistics heavily in this direction. On the other hand, psychology continued to be quite interested in the concept of language performance (Cowles 2011: 16). Nonetheless, several of Chomsky’s proposals about the nature of syntactic structure and his work on transformation grammar prompted psychologists’ experimentation in the 1960s to see whether the linguistic processes proposed were also the psychological processes.

However, taking into account the brain’s neurological aspects and its connection to language, the most crucial researchers were Paul Broca [1824–1880] and Carl Wernicke [1848–1905]. Their study on aphasia is considered as a beginning of neurolinguistics (Zubicaray and Schiller 2019: 19–20). Broca noticed that even though a patient’s brain was harmed very broadly, the damage seemed to be located in the inferior frontal gyrus of the left frontal lobe, directing him to hypothesize that this brain region is responsible for the capacity to speak aloud (Zubicaray and Schiller 2019: 19–20). Broca’s statement generated a significant interest, and numerous similar cases had been described. A few years after his first case, Broca had discovered that virtually all reported aphasia cases involved damage to the left hemisphere, almost all involved a concomitant paralysis of the right hand, and aphasia rarely occurred after damage to the right hemisphere. From these observations, Broca concluded that language must be localized in the left hemisphere describing Broca’s Aphasia (Broca 1865) (in: Zubicaray and Schiller 2019: 19–20). Ten years later, Carl Wernicke, a young German physician, reported two patients with damage to the posterior superior temporal lobe and deficits in language comprehension suggesting that there was not a single language area, but multiple language areas with distinct functions (Zubicaray and Schiller 2019: 19–20). Wernicke created an exceptionally prescient theory of language’s neural organization presenting Wernicke’s aphasia.

In the mid-1970s, it was popular to argue that the significant division between lexical and rule-governed aspects of linguistic competence (a fundamental division in the linguist’s ‘anatomy of language’) is reflected in the significant symptom clusters of Broca’s and Wernicke’s aphasia. Certainly, agrammatism is a prominent feature of Broca’s aphasia, and the fluent speech of Wernicke’s aphasics is conspicuous for its lack of lexical content (Ingram 2002: 65). At the time, psycholinguistic experimenters had just discovered what was to be hard evidence for a specific deficit in syntactic processing in Broca’s aphasia, which blocked the comprehension of semantically reversible sentences containing critical syntactic cues (Ingram 2002: 65). Broca’s area is associated with speech production and Wernicke’s area with the auditory comprehension of speech sounds. This is partly due to the constellation of impairments that appear in either the production or comprehension of language (or indeed both) when patients suffer from brain damage in these particular areas (Cowles 2011: 95). In many ways, Wernicke’s aphasia is the opposite of Broca’s – patients with this aphasia speak fluently and have no trouble with function words. However, the speech’s content is often not meaningful and may even contain word-like strings of sounds that are not words. Alternatively, they may produce novel ways to refer to things, such as calling an egg “hen-fruit” (Cowles 2011: 96). In terms of comprehension, patients often show clear signs of auditory comprehension difficulties, and they commonly have visible difficulties repeating spoken words.

In essence, neurolinguistics includes almost the same range of topics as psycholinguistics does, i.e. all aspects of language processing; however, it is considered from the different scientific perspectives and methodologies. While psycholinguistics is the study of the interrelation between linguistic factors
and psychological aspects, neurolinguistics is studying the neural mechanisms in the human brain that control the comprehension, production, and acquisition of language. The origins of neurolinguistics can be found in the research on aphasia conducted by Carl Wernicke and Paul Broca. Nonetheless, it were Wernicke’s students and his successors who continued and creatively developed their master’s projects within this area before the Second World War at Breslau Universität.

2. Academic neurolinguistics

Traces of Carl Wernicke, the Breslau school, and the history of aphasia can be found globally in periodicals, articles, and books available in libraries in many locations. Many original texts may be found in Wroclaw (Breslau), Berlin and Frankfurt am Main. One group of source texts is now available at the University of Wroclaw’s library. The origins of psychiatry are associated with the medical faculty of the University of Wroclaw, where in 1836, Henrich Neumann initiated academic lectures on psychiatry. Carl Wernicke-Neumann’s successor created the famous school “Breslauer Psychiatrische Schule” (Kiejna 2011: 11). The representatives became an inherent part of the history of medicine; therefore, Wroclaw can now be classified as one of the major centers of research in the field of diseases of the nervous system in Europe. Nonetheless, Breslau and the representatives were strongly connected with other cities and institutions, such as Charité Institute in Berlin or Frankfurt University, where significant discoveries on language and brain took place.

The University of Wrocław

The University of Wrocław (in Polish: Uniwersytet Wrocławski; in Latin Universitas Wratislaviensis) is a university founded in 1702 as a Jesuit college (Bobowski 2004: 471–485). Nonetheless, the breakthrough regarding studies on the brain and language came in 1876 when the formal University Psychiatric Clinic was established, although there were no lecture halls, for which the rooms in the hospital of all saints were used. Furthermore, Neumann obtained habilitation and professorship in the field of psychiatry as an academic psychiatry was already found in Breslau as an independent field. Another figure of Breslau psychiatry was Carl Wernicke – professor of psychiatry and neurology, who, in 1885, became the director of the clinic (Kiejna 2011: 19–20). At the turn of the 19th and 20th centuries, Breslau was an intensively developing center. Wernicke fought for an independent university clinic, which was finally established under Bonhoeffer.

The German university – Universität Breslau was dissolved in 1945, and a Polish university was founded in its place in 1946. Breslau, now known as Wrocław, became part of the Republic of Poland. The first Polish team of academics arrived in Wrocław in late May 1945 and took custody of the university buildings, which were in 70% destroyed (Ilowiecki 1981: 241). Unfortunately, parts of the collection of the university’s library were lost during the Red Army’s advance in 1945 (Richards 2015: 30). The University of Wrocław has facilities located practically all over Wrocław. The oldest and essential part is a campus located in the Old Town which dates back to the 18th-century Leopoldine Academy. Other facilities are located south of the Wrocław Główny railway station, now housing the institutes of the

Faculty of Historical and Pedagogical Sciences, and previously belonging to the Gymnasium of St. Mary Magdalene\(^5\). After the political changes in Poland in the 1990s, the university took over the post-military facilities in Koszarowa Street, where the campus of the Faculty of Social Sciences was established.

Figure 1. The entrance of the University of Breslau and the view on the Breslau University of the Oder. Source: Bonhoeffer, Karl (1990) *Leben und Werk eines Deutschen Psychiaters und Neurologen in seiner Zeit*. Location: Central Library – Universitätsbibliothek Frankfurt.

Another group of source texts is available in Charité Medical Humanities (Bibliothek für Geschichte der Medizin und Soziale Medicine) in Berlin. The Library of History of Medicine and Social Medicine, “Library Medical Humanities,” is a branch library of the Charité Medical Library and joins the specialist literature of Charité Centrum. The library manages and organizes scientific work resources and supports research projects by researching and providing literature, images, and other sources. At the location Thielallee 71 in Berlin-Dahlem, the library is available to all teachers, researchers, students, and the interested public during opening hours. It is worth adding the Medical Humanities Library is a member of the Association of Medical History and Related Libraries. The establishment of the first separate wards for neurological patients at Berlin Charité Hospital in 1865 was an important starting point for German neurology. Many important figures have worked there such as Carl Wernicke who worked in the psychiatry clinic of the Charité academic hospital from 1876 to 1878 or Karl Bonhoeffer who succeeded Theodor Ziehen (1862–1950) as a full professor of psychiatry and neurology at the University of Berlin and who was a director of the university clinic of psychiatry and neurology at the Charité Hospital.

Figure 2. Psychiatric and mental hospital of the Charité: source Bonhoeffer, Karl (1990) Leben und Werk eines Deutschen Psychiaters und Neurologen in seiner Zeit. Location: Central Library – Universitätsbibliothek Frankfurt.

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The Frankfurt University (Goethe University Frankfurt)

Another group of materials comes from the Frankfurt University Library [German: Universitätsbibliothek Frankfurt am Main or Universitätsbibliothek Johann Christian Senckenberg] the Goethe University of Frankfurt, Germany. It originated in the 15th century as a town library. Johann Wolfgang Goethe University in Frankfurt\(^7\) (German Johann Wolfgang Goethe-Universität Frankfurt am Main), in short University of Frankfurt am Main (official name until 1932), the University of Frankfurt is a German university founded in 1914 in Frankfurt am Main and named in 1932 after Johann Wolfgang Goethe [1749–1832], the most famous inhabitant of this city. The first plans for a university in Frankfurt am Main were at the end of the 14th century, when the city council tried to relocate the university from Paris to Frankfurt am Main (Jung 1915). After the destruction of Heidelberg on May 22nd, 1693, by French troops, the professors of Heidelberg University relocated to Frankfurt am Main and established themselves there in 1694 under the rector Johann Ludwig Fabricius [1632–1696] as a university in exile (Hautz 1862: 228–230). That did not last permanently in Frankfurt am Main and was relocated to Weinheim in 1698, where a temporary residence of the Palatinate Elector Johann Wilhelm was.

\(^7\) About University Library Johann Christian Senckenberg. Retrieved from https://www.ub.uni-frankfurt.de/ueber/ueber_en.html [date of access: 14.08.2020].

\(^8\) Niemcy. Ważniejsze szkoły wyższe (1993). [In:] Encyklopedia PWN:https://encyklopedia.pwn.pl/haslo/;446970 [date of access: 05.06.2020].
Concerning psychiatry, Frankfurt am Main is associated with the Wernicke-Kleist-Leonhard school of psychiatry (Malhotra and Chakrabarti, 2015: 103). Karl Kleist [1879–1960] worked as a resident physician during Wernicke's directorship in Halle; later, he became head of the psychiatry department in Frankfurt am Main. In 1924 he coined the term “cycloid psychosis” (Malhotra and Chakrabarti 2015: 103). Kleist shared his clinical interests with Karl Leonhard [1904–1988], his collaborator in Frankfurt, from 1936 to 1950. Furthermore, Alois Alzheimer in 1889 started working in a psychiatric institution (Städtische Anstalt für Irre und Epileptische) in Frankfurt am Main. Moreover, Karl Heilbronner was a volunteer at the Senckenberg Institute in Frankfurt, where he completed his anatomy knowledge.

Today, the Frankfurt University Library is one of Germany’s largest academic libraries with its extensive holdings and collections; the Frankfurt am Main University Library is one of the central academic libraries in the Federal Republic of Germany. It combines a scientific library for Frankfurt and the Rhine-Main area, a university library with numerous national tasks, and a focused library within the regional supply of literature. The Frankfurt University Library is a member of the Collection of German Prints, the virtual German national library, covering years from 1801 till 1870. The selected works connected to neuroscience and their titles and covers are presented in the next section.

3. Breslau School of neurolinguistics

The beginnings of academic neurolinguistics in Breslau can be traced back to the development of psychiatry as a medical specialty from which neurology emerged and its first representatives’ scientific achievements. One of the founders of the local neuropsychiatric school was Heinrich Neumann [1814–1884]. In 1874, Neumann established a psychiatric clinic as a separate research and teaching facility at Alma Mater in Breslau (Kiejna 2011: 18–19). The growing needs in the field of psychiatric care led to building a new facility located at today’s ul. Kraszewskiego 25. Unfortunately, Neumann’s death in 1884 prevented him from seeing the construction’s completion. The new institution was led by his student and successor, Carl Wernicke. As per Kiejna (2011: 24), Breslau was a modern, developing city with the proper conditions for research work. Moreover, it became an important research center as attractive buildings were erected such as university complex or a new modern psychiatric clinic.

Traces of Carl Wernicke, the Breslau school, and the history of aphasia can be found globally. Periodicals, articles, and books presenting the origins of neurolinguistics are available in libraries in many locations. Today, a lot of original texts may be found in Wroclaw, Berlin and Frankfurt am Main as in these cities significant German scientists conducted the research. Therefore, selected materials with description of the location and signatures are presented in this section to help the researcher to find them easily.

3.1. Heinrich Neumann [1814–1884]

Heinrich Wilhelm Neumann was (born January 17th, 1814 and died October 10th, 1884 in Wroclaw) – German psychiatrist, professor of psychiatry at the University of Breslau. He studied medicine at the University of Breslau and in 1836 obtained a doctorate degree. In 1842 Neumann obtained his habilitation in internal medicine (Kirchhoff 1921: 261–265). From 1846 to 1849, Neumann was an assistant at the Mentally Sick department in Lubiąż (in German: Irrenheilanstalt in Leubus). In 1862 Neumann obtained his habilitation in psychiatry and became an associate professor. From 1867 until his death in
1884, he was head of the psychiatric ward of the All Saints’ Hospital (in German: Allerheiligen-Hospital) in Breslau. Carl Wernicke was his successor. Moreover, one of H. Neumann’s assistants in the years 1869-1972 was Ludwig Lichtheim [1845–1928], who together with Wernicke created an original model of the pathomechanism of aphasia (The Wernicke-Lichtheim model). Referring to “A History of Psycholinguistics” prof. Levelta p. 74, you can find the information that “Lichtheim must have been aware of his revealing contribution to the theory of aphasia as he simultaneously published his extensive article On Aphasia (1885) in both German and English."

3.2. Carl Wernicke [1848–1905]

Carl Wernicke was born on May 15th, 1848, in Tarnowitz, now Tarnowskie Góry. He began schooling in his hometown. As there was no gymnasium at the location at that time, he studied at the Royal Gymnasium in Opole, and then at Maria Magdalena’s Gymnasium in Breslau. After graduating from high school, in the challenging years 1866–1870 for the Prussian state, he studied medicine at the Fryderyk Wilhelm University in Breslau (Kiejna and Wójtowicz 1999: 9). After obtaining his doctor’s diploma and doctoral promotion, Carl Wernicke briefly became involved in a professional relationship with the Breslau ophthalmologist, Professor Richard Förster [1825–1902].

The political situation in Europe, however, prevented this uninterrupted cooperation as the beginning of Wernicke’s medical studies coincided with the Prussian-Austrian War. As a graduate of the medical faculty, Wernicke was drafted into the army; this was the first major obstacle on his difficult path to his career (Kiejna 2011: 20–21). The war ended after ten months, so the young doctor could soon resume his professional and scientific work. However, Wernicke did not return to ophthalmology and chose to work in the psychiatric ward led by Heinrich Neumann. In 1874, at the age of only 26 and working as an assistant at All Saints’ Hospital in Breslau, he published his monumental work Der aphasische Symptomencomplex which brought him worldwide fame.

In this dissertation, Wernicke presented his observations and research on the speech centre’s location, its damage, and related neurological and psychiatric disorders. At that time, a young and unknown doctor located and described the speech centre on the lateral surface of the left temporal lobe. Thanks to Wernicke, it is possible to give its location even more precisely – in the posterior part of the upper left temporal gyrus. The described location was given the
The next significant stage of Wernicke’s career was work in the psychiatry clinic of the Charité academic hospital in Berlin. From 1876 to 1878, Wernicke served as a first assistant under Karl Westphal [1833 –1890] in the clinic for psychiatry and nervous diseases (Kiejna and Wójtowicz 1999: 9). After leaving Charité in 1878, Wernicke remained in Berlin and ran a private neurological practice. Therefore, after the death of the director of the Breslau psychiatric clinic (Neumann), Wernicke accepted the proposal to take over the facility. Wernicke’s arrival in Breslau coincided with constructing a new psychiatric facility; the clinic was moved to a new facility in 1888, thus becoming an independent institution. In 1890 he attained the chair at Breslau, later performing similar functions at the University of Halle in 1904, heading its Psychiatry and Neurology Clinic (Kiejna and Wójtowicz 1999: 9).

Professor Wernicke’s scientific independence resulted in the emergence of subsequent publications in which he announced the results of his explorations. In 1893, a collective monograph edited by him was published, entitled Gesammelte Aufsätze und Kritische Referate Zur Pathologie des Nervensystems (Collected essays and critical articles on the pathology of the nervous system). Another publication published in 1906 was the volume Grundriss der Psychiatrie in kielischen Vorlesungen (An outline of psychiatry in clinical lectures).

The first lecture of the monograph concerns the mentally ill and brain disorders. Brain diseases are defined as diseases of the projection system, mental illnesses as common diseases of the association organ — opposite of primary and secondary identification in the language. Wernicke (1906: 1) believes mental illness is a branch of internal medicine, which requires and special treatment. Wernicke (1906: 2) points out melancholy and the sentimental mood as mental disorders. At the same time, he readily admits that psychiatry has made considerable progress in his times. Wernicke believes the teacher of psychiatry is instructed to dwell on symptomatology over the expense of applying the standard of another discipline. The presupposition that mental illnesses as brain diseases is probably no longer disputed by any professional. Another significant work was the three-vol-
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Figure 7. Wernicke, Carl (1906) Grundriss der Psychiatrie. Location: Charité medical library.

Fundamental work *Anatomischer Atlas des Gehirns* (Atlas of the Anatomy of the Brain), which Wernicke prepared with his colleagues, recognized in the medical world. Among the authors was Otfrid Foerster [1873–1941], Wernicke’s assistant, later a pioneer of German and world neurosurgery.

### 3.3. Otfrid Foerster [1873–1941]

Otfrid Foerster (born November 9th, 1873 and died June 15th, 1941, in Wroclaw) – German neurologist, professor at the University of Breslau. Foerster was a world-famous student of Wernicke. He pioneered neurosurgery, contributing to the field’s development at a tremendous pace in the late 19th century (Kiejna 2011: 22). He attended Maria Magdalena’s grammar school in Breslau and studied at the University of Breslau. He passed the medical examination in the academic year 1896/97 and received his doctorate in March 1897. Carl Wernicke [1848–1904] sent Foerster to study with the famed neurologists’ Joseph Jules Dejesine [1849–1917], Pierre Marie [1853–1940] and Joseph Babinski [1857–1932] in Paris (Kiejna 2011: 22–23). Foerster returned to Breslau in 1899 and assisted Carl Wernicke, with whom he published an atlas of the brain in 1903. After writing his habilitation thesis in 1903, he was appointed an associate professor.

After receiving the full professor’s title in 1921, he lectured at the Faculty of Medicine of the University of Breslau. He was one of the pioneers of world neurosurgery. Moreover, he was an honorary member of many foreign neurosurgical societies and a corresponding member of the Warsaw Neurosurgical Society 1922 (Aminoff and Daroff 2014: 335–336). Foerster established the first department of neurology in Germany in 1911. In 1917, at the age of 35, he was appointed professor of neurology at Breslau. In 1921, he led a department in the Wenzel-Hancke Krankenhaus, a large municipal hospital. With support from the Rockefeller Foundation, the Institute of Neurology was built next to the hospital in 1934. His fame as a neurologist spread throughout Europe. His most famous patient was Russian revolutionary Vladimir Lenin [1970–1924], whom he treated for two years after Lenin suffered a stroke in 1922 (Aminoff and Daroff 2014: 335–336).

Otfrid Foerster made a considerable contribution to the development of neurological and neurosurgical research worldwide. He also made Breslau a renowned center for scientific study, attracting researchers from around the world (Kiejna 2011: 22–23). His achievements influenced many neurosur-

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Figure 8. A memorial board dedicated to Otfrid Foerster, University of Wrocław. Photography: A. Daniel, 07.06.2020.

Figure 9. Zülch, Klaus-Joachim (1873) Otfrid Foerster – Arzt und Naturforscher. Book describing the biography of Otfrid Foerster as a physician and naturalist. Location: Central Library - Universitätsbibliothek Frankfurt.

geons during his lifetime. As a professor of the University of Breslau from 1917 to 1938 and an employee of the University Psychiatric Clinic, he developed an operational method of treating epilepsy. Until the end of his life, Foerster was associated with Breslau, which is commemorated by the board on the present University of Economics building. Foerster – as a student and later a close associate of Wernicke was a co-author of the Brain Atlas, but also a pioneer of the method of electrical brain stimulation in the operations of patients with epilepsy, which was borrowed and developed by Wilder Penfield [1891–1976] for mapping the brain known today as electroencephalography (Levelt 2012: 562). Penfield was a Canadian neurosurgeon, co-founder of transactional analysis, member of the Royal Society and other scientific and professional associations, awarded with honorary doctorate degrees from numerous universities in North America, Europe and Asia (including Princeton, Oxford, McGill in Montreal, also Warsaw), awarded with high decorations (including the Medal of Freedom (USA), the French Legion of Honor, the British Order of Merit and the Order of Saint Michael and Saint George.

It is worth adding that after Foerster there was coined the term describing compulsive punning called the Foerster’s syndrome characterized by manic compulsive punning induced by the midbrain’s stimulation (Tatu and Bogousslavsky 2016: 188). His doctoral thesis on typhoid fever in 1897 was the only one of his 300 publications unrelated to the nervous system (Aminoff and Daroff 2014: 335). At the University of Breslau, Foerster was strongly influenced by Carl Wernicke.
3.4. Karl Heilbronner
[1869–1914]

Karl Heilbronner attended an elementary school in Nuremberg, then a gymnasium in Munich. He studied medicine at the Ludwig and Maximilian University in Munich and received the doctor of medicine title in 1893 (Peiffer 2004: 1019). Subsequently, he was a volunteer at the Senckenberg Institute in Frankfurt am Main for a short time, where he completed his anatomy knowledge. From 1893 to 1898, he was an assistant to Carl Wernicke at the Department of Psychiatry and Nervous Diseases in Breslau (Peiffer 2004: 1019). In 1898 Heilbronner became head of the clinic of psychiatry and neurology in Halle. In 1901 he became a professor and in 1903, was appointed to the chair of psychiatry at the University of Utrecht, where he replaced Theodor Ziehen [1862–1950]. In the obituary of Wernicke, which appeared in the Allgemeine Zeitschrift fur Psychiatrie in 1905, Heilbronner wrote that the psychiatry of Wernicke has not yet found an actual ending due to his tragic accident (Lanczik 1988: 66). Karl Heilbronner believed it was impossible to separate psychiatry and neurology by dealing mainly with apraxia and organic causes of mental illness.

3.5. Karl Bonhoeffer
[1868–1948]

One of the most important successors of Wernicke’s was Karl Bonhoeffer10. In 1874–1878, Karl Bonhoeffer attended an elementary school in Heilbronn and Ravensburg, from 1878 to 1886, he attended a gymnasium in Tübingen, then in the years 1886–1887, he served in the army in Stuttgart. After receiving a license to practice, he worked in Heidenheim an der Brenz. As a doctor who completed military service, he was promoted to a medical officer. After a few years, he became head of a psychiatric clinic and an observation station for “mentally ill criminals” in Breslau. In 1897, he obtained his habilitation at the University of Wroclaw. It was there where Bonhoeffer’s scientific works on the consequences of alcoholism, degenerative processes in the brain, and symptomatic psychoses were created, which guaranteed him recognition. From 1903 to 1904, he worked in Królewiec (in German: Königsberg) and Heidelberg. In 1904, as the successor of Carl Wernicke, he took over the chair at the University of Breslau (Kiejna 2011: 23).

In 1912, Karl Bonhoeffer succeeded Theodor Ziehen [1862–1950] as a full professor of psychiatry and neurology at the University of Berlin and director of the university clinic of psychiatry and neurology at the Charité Hospital. He held these positions until his retirement in 1938. Bonhoeffer intended to establish psychiatry as an independent medical discipline and to develop it further. He advocated that “nervous suffering and temperaments” should also be handled by specialist doctors’ offices (Rasmussen 1970: 136). As a forensic officer, Bonhoeffer was responsible for all areas of psychiatric diagnostics, so he was also responsible for assigning the prepared diagnosis an appropriate professional term, which was binding in the penal code at the time. Interestingly, Karl Bonhoeffer presented the psychological evidence that proved Adolf Hitler’s mental health made him entirely incapable of ruling a nation (Rasmussen 1970: 136).

Bonhoeffer (1896: 1) in his work “Seitenstrangerscheinungen” Bei akuten Psychosen admitted that on the subject of acute psychosis, he had made an observation several times, which, as far as he knew, had yet received no attention in the literature. Not because the phenomenon was rare, but it was overlooked even if a person was not accustomed to it or during the most acute and agitated stages of the disease. Interestingly, Klaus Bonhoeffer [1901–1945], Bonhoeffer’s elder son, was a well-known German lawyer and member of the anti-Nazi opposition who was accused of the attack on Adolf Hitler. As Karl Bonhoeffer has been forced to sterilize the mentally ill he ultimately left Breslau. At that time, psychiatry often served politics and totalitarian doctrines (Kiejna 2011: 24).
Nevertheless, great names such as Alois Alzheimer still appeared in Breslau. Famous researchers have come here to conduct their scientific and clinical activities.

3.6. Alois Alzheimer [1864–1915]

Figure 13. A memorial board dedicated to prof. Alois Alzheimer11

Figure 14. Grave of Alois Alzheimer and his wife Cecylia.12

11 Photography taken by Aneta Daniel on 05.04.2019.
12 Hauptfriedhof (Frankfurt am Main) Photography taken by Aneta Daniel on 31.05.2019.
Alois Alzheimer was born in 1864 in the Bavarian town of Marktbreit. In 1883 he started medical studies in Berlin (Stertz 1953: 236). He also studied in Tübingen and Würzburg, where in 1887 he obtained a medical doctor diploma. In the same year, he presented his doctoral dissertation on the histology of the wax glands, based on his research in the laboratory of Rudolf Albert von Kölliker. In 1889, he started working in a psychiatric institution (in German: Städtische Anstalt für Irre und Epileptische) in Frankfurt am Main (Stertz 1953: 236). In 1912, as a full professor, he became head of the Department of Psychiatry at the University of Breslau and director of a psychiatric clinic (in German: Königlich Psychiatrischen und Nervenklinik). Alzheimer collaborated with Wernicke’s students such as Foerster, who were among the leading representatives of his school. Speech and language disorders are, of course, one of the symptoms of Alzheimer’s disease, but in the Wrocław period, Alzheimer did not publish any research in this field, although here many eminent scientists specializing in brain research gathered in his Laboratory including Hans-Gerhardt Creutzfeldt [1885–1964], Frederic Lewy [1885–1950], Gaetano Perusini [1879–1915], Max Bielschowsky [1869–1940].

Alzheimer described one of the best-known diseases these days – the most common cause of dementia in the elderly, Alzheimer’s disease, a progressive neurodegenerative illness characterized by a spectrum of clinical features and neuropathologic findings (Feldman 2007: 1). Cognitive impairment and psychiatric disturbances in Alzheimer’s disease (AD) result from dysfunction and degeneration of synapses, and consequent death of neurons, in the limbic system and associated regions of the cerebral cortex (Tarazi and Schetz 2005: 51). Alzheimer’s disease is a devastating, and always fatal, neurodegenerative disorder characterized by progressive impairment of cognitive function and emotional disturbances.

In 1915 Alzheimer’s health deteriorated rapidly. He suffered from heart problems, shortness of breath and kidney failure. He died shortly afterwards in Breslau, on December 19th, 1915, at the age of 51. He was buried at the Main Cemetery in Frankfurt am Main, next to his wife. The relationship between Alzheimer’s and Wrocław was commemorated in 1995 with the initiative of Andrzej Kiejna, with a commemorative memorial board (Kiejna 2011: 29). The board is located on the front wall of the former director’s villa at number 42 at today’s Bujwida Street.

3.7. Hugo Liepmann [1863–1927]

In 1895 Liepmann received the title of doctor of medicine in Berlin. In the years 1895–1899 he was an assistant to Carl Wernicke at the Psychiatric and Nervous Diseases Clinic in Wrocław, and later became a professor of neurology at the Friedrich

Figure 17. Das Krankheitsbild der Apraxie (motorischen Asymbolie) Kl.schr. 10726. Source: Liepmann, Hugo (1900) Das Krankheitsbild der Apraxie (motorischen Asymbolie). Location: Central Library – Universitätsbibliothek Frankfurt.

Wilhelm University in Berlin. From 1915 he was director of the psychiatric hospital in Herzberge (today Berlin Lichtenberg) (Peiffer 2004). At the end of his life, he suffered from Parkinson’s disease, committed suicide after another exacerbation of the disease.

3.8. Ernst Storch [1866–1916]

German psychiatrist and private docent at the University of Breslau. He was the son of Heinrich Storch (1825–1883), a secondary school teacher from Bolków [1]. He received his secondary school-leaving examination certificate in middle school in Dzierżoniów (1884) and Świdnica (1885), then he studied medicine at the University of Wroclaw. He passed his medical examinations in 1891. For the next 2.5 years he practiced in Domanice, for three years he worked as an assistant at the pathological institute in Wroclaw, and finally, from April 1898, as an assistant in the psychiatric clinic in Wroclaw under Carl Wernicke. He received the title of doctor of medicine in 1899 after presenting the dissertation Über 2 Fälle von Lungenarterienaneurysma. He obtained his habilitation in 1901 on the basis of the work of Psy-
Aneta Daniel


German-American neurologist and psychiatrist, is considered a pioneer in the fields of neuropsychology and psychosomatics. Goldstein studied under Carl Wernicke and Ludwig Edinger, where he concentrated on psychiatry and neurology. Goldstein's father reluctantly permitted him to enroll at the University of Breslau. Before he moved to the University of Heidelberg, Goldstein remained there for just one semester, where he was able to research Neo-Kantian philosophy and literature and where he was introduced to Carl Wernicke's concepts. Goldstein returned to Breslau one year later to study medicine. Goldstein based his studies on neurology and psychiatry under the directions of Carl Wernicke. At the age of 25, Goldstein received his medical degree (Harrington, 2000). Goldstein was invited to the Senckenbergisches Neurologisches Institut at the University of Frankfurt in 1903 by Ludwig Edinger, where he became Edinger's assistant (Oct 1903 – Sept 1904). In October 1934, Goldstein immigrated to the United States of America. He served as a neurologist at the Psychiatric Institute in New York City and formed ties with Columbia University in New York. In Boston, Goldstein served as a clinical professor of neurology between 1940 and 1945. He moved back to New York City in 1946, where he founded a private practice.

Thanks to the discoveries and research conducted, especially in Wrocław, the neurolinguistics could have been developed. Other scientists are more tightly connected to neuroscience; scientists shaped and led by Carl Wernicke can now be called the Breslau school of neurolinguistics.

Conclusions

Scientists from Wrocław participated in German and world psychiatry, and their views influenced the shape of neurolinguistics. Today – from the perspective of the entire century that has passed since the death of the German doctor Carl Wernicke – one can make a thesis about the universal dimension of his scientific achievements with all responsibility. He was not only a psychiatrist, neurologist but also an

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anatomist, pathologist, and neuropathologist. Wernicke was an individualist who was scientifically far ahead of his time and was a model for representatives of several medicine fields. The article’s principal target is the recreation of a group of researchers – the students of Carl Wernicke. Selected profiles of the researchers were presented, and their achievements in the brain research and neuroscience in Breslau and other cities were acknowledged. The research conducted by German doctors from which neurolinguistics emerged shows how psychiatry, psychology and neurology are tightly connected and dependent on each other. The materials found in Wroclaw, Berlin, and Frankfurt am Main are of great importance and help list the scientists whose discoveries led to neurolinguistics development.

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