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Psychological Machinery

Experimental Devices in Early
Psychological Laboratories



Introduction

After centuries of polemic disputations about how body and mind are related, what the role human consciousness is, or how human soul can be healed, the acceptance of scientific methods moved psychology closer to evidence-based natural sciences. The inception of scientific psychology with its experimental devices and instruments at the end of the 19th century can be considered as the first step towards the establishment of a well-organized and critical research of human mind. Wilhelm Wundt himself noted that psychological introspection should come hand in hand with methods of experimental physiology. The application of these methods on psychological introspection would lead to the psychophysical method as an independent discipline in the field of experimental research.

At the end of the 19th century, the highly advanced discipline of physiology contributed to the birth of modern scientific psychology by providing elaborated experimental instruments and devices. First psychological laboratories were established, and the researchers gradually adapted the physiological instruments to their own needs, or started to design their own instruments according to specific research goals.

In this book we focus primarily on that part of psychological history, which is not – despite its considerable significance – completely covered in the relevant literature. More specifically, we will describe experimental instruments and devices used in psychological research at the turn of the 20th century. The book was inspired by the unique collections of historical apparatus kept on the premises of Masaryk University in Brno and Charles University in Prague, as well as the collection maintained by Technical Museum in Brno. These collections comprise a set of instruments which represent typical experimental equipment found in any respectable university laboratory in Europe of that time. Our efforts focused on identification, classification and description of mechanical design of most relevant instrumental equipment. Technical details are supplemented with the description of each instrument's purpose and operation. In some cases we also tried to map the process in which experimental psychologists used their ingenuity in incorporating contemporary advances in technology into the construction of even more sophisticated devices. These advancements illustrate the progressivity of psychology as an independent scientific field which is able to absorb new pieces of information from different areas of science and engineering and integrate them into its own methodological base.

The Origins of Psychological Laboratories

At the very beginning, psychology was driven by joint efforts of scientists from various fields, such as physiology, philosophy, or biology (Harper, 1950). These fields shared a common object of interest, but they examined it with different methods and from different perspectives. Continual cooperation between the researchers combined with ceaseless sharing of ideas eventually led to the establishment of experimental psychology as a separate scientific discipline. The viability of the new field was proven with the founding of the first psychological laboratories in the last quarter of the 19th century. The work environment and instrumental equipment of psychological laboratories predetermined research interests and opportunities in such a way, that the laboratory as a whole could be viewed as a universal research tool.

The laboratory of Prof. Wilhelm Maxmilian Wundt (16 August 1832 – 31 August 1920) is considered the first psychological experimental facility. The laboratory was established at the Leipzig University¹, thus securing the university a prominent position in the history of psychology. It served as a gold standard for all latter laboratories spread around the world, as mentioned by McK. Cattell in 1888 (p. 39): “It is interesting to note that the example set by Wundt at Leipsic is being followed in other universities. Psychological laboratories have been established or are being planned at Berlin, Bonn, Göttingen; in America, at Johns Hopkins, Harvard, Pennsylvania and Princeton; in England at Cambridge; also at Copenhagen and elsewhere.” The Leipzig Institute – as Wundt used to refer to his own laboratory – was also an important centre of development of new instruments. Experimental work on verifying postulated theories often required construction of new prototypes able to measure the target characteristics or adaptation of instruments known from the field of experimental physiology. Wilhelm Wundt made good use of his university education in medicine and physiology, as well as of his internship with Hermann von Helmholtz and collaboration with physiologists Johannes Müller and Emil du Bois-Reymond.

Wundt’s interest in experimental work naturally anteceded the moment of founding his well-known laboratory, which is illustrated in the diary of Czech philosopher Josef Dastich. This scholar travelled across Europe and visited famous scientists, among others also Helmholtz and, in 1865, Wundt in Heidelberg (Lifka, 1923): “... Then I had been looking for Prof. Wundt for a long time, even though he lived on the main street across from the Institute; I did not ask, rely-

1 The Leipzig University was established in 1409 by German teachers and students who left Prague during the reign of King Wenceslaus IV (Otto, 1900, p. 83). The structure of Leipzig University therefore resembles the organization of Charles University in Prague.

ing on ‘Personalstand’ – in fact he moved to a new apartment in the ‘zum Riesen’ house. He lives with his parents – judicial councilor – he has a very kind mother; he welcomed me very warmly. We discussed local conditions and I am grateful for many advices. The next week he will start a new, for me personally interesting, series of lectures ‘Anthrop’. He reads in his apartment and willingly offered me, almost before I asked him, to come and see, if I could make use of any of it. Also to visit his instrument collections and perform some experimental trials together. Naturally, I’ll be glad to do both...”

Wundt’s laboratory grew up from very humble beginnings. After a year spent at the University of Zurich, in May 1875 Wundt received a letter from Friedrich Zarnke from Leipzig with an offer of a ‘modest position’ at the university. This position represented only a half of what was originally a single professorial post, and the other half was offered to Max Heinz from Königsberg. After a brief consideration Wundt accepted and in the very same month (October 1875) was appointed a regular professor of philosophy. In addition to that, the Royal Ministry with the agreement of the academic senate assigned him several rooms in the university Konvikt building (Wundt, 1920). Wundt used these rooms as storage space for his experimental instruments and teaching requisites. In 1879 he founded his own private institute which only occupied four rooms where students started doing experimental work under his supervision. Therefore, 1879 is recognized as the year of the first psychological laboratory foundation (Boring, 1950).

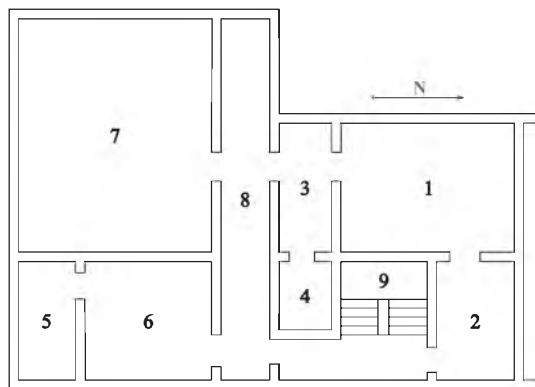


Figure 1. The layout of Wundt’s laboratory in Konvikt (Hoskovec, Nakonečný, Sedláková, 2003). Detailed description is provided in the text.

Among the first students of Wundt’s institute one can find famous names like G. Stanley Hall and Max Friedrich. We can hypothesize that these two psychologists were most likely the first experimenters as there are records from data collection for Friedrich’s thesis (On the Duration of Apperception of Complex Im-

ages) conducted in December 1879, which in 1881 also became the first doctoral thesis defended at the Institute (Benjamin, 1997). Since 1879 Wundt's laboratory provided courses and workshops, even though they were not listed in the official university study programs. Only in the summer semester 1881 Wundt's laboratory classes was first introduced to the study program. Some of the most notable students in these early years included Emil Kraepelin, G. Stanley Hall, and Wundt's future assistant James McKeen Cattell.

Another significant year was 1883 when the Royal Ministry officially approved funding for the Private Institute, and on June 26 the Institute became a part of the university as the 26th department called the Institute for Experimental Psychology. Soon after that, the university advertised for the post of an assistant at the Institute and the Seminar on Experimental Psychology could appear in the university study program (Wundt, 1909). At the same time, the Institute was assigned two additional rooms formerly used by the Institute of Pharmacology. Figure 1 depicts the new layout of the Institute (Benjamin, 1997) – lecture rooms (1 and 7), conference room (2), waiting room (3), darkroom (4), laboratories (5 and 6), and hallway (8) with staircase (9). The rooms were newly equipped with gas fixtures for proper lighting and electricity for instruments requiring higher voltage than voltage provided by batteries (Benjamin, 1997). A subjective review of the Institute was provided by Krohn (1892), who considered some of the instruments obsolete and deserving replacement, usable mainly for demonstration and educational purposes. He also remarked that the laboratory rooms were equipped with good lighting, but very bad quality floors. On the other hand, Krohn also made a reference to the sophisticated Ludwig-Baltazar's kymograph, which was only owned by two laboratories at that time – Wundt's laboratory in Leipzig and the laboratory in Bonn. At the institute Krohn also mentioned meeting with August Kirschmann (later a director of the Psychological Laboratory at the University of Toronto) and Oswald Külpe (founder of the laboratory in Würzburg).

In the early years the Institute engaged in various research activities. Cattell (1888) classified the research interests into four areas: (1) Analysis and Measurement of Sensation; (2) Duration of Mental Processes; (3) Time-Sense; and (4) Attention, Memory and Association of Ideas. In 1883 the Institute undertook in total 19 research projects with worldwide student participation, comprising Americans, Russians, Scandinavians, Czechs, Greeks, and Frenchmen. The publication of the journal *Philosophischen Studien* was launched in the same year. The contents of the journal were primarily devoted to the laboratory's research methods and findings.

Starting in 1890, the university experienced considerable growth, which also significantly influenced Wundt's laboratory. In connection with a complex reconstruction of the university, the Konvikt building was torn down, and the Institute

was temporarily moved to the Triersche Institut on the Grimmaischen Steinweg Street. At the Triersche Institut Wundt's laboratory found its place on the second floor of the Grimm Haus on Steinweg 12, Leipzig, where it occupied eleven offices. This increment in space enabled further expansion of the laboratory by means of admitting more students and extending its research activities. In summer 1894 another assistant position was approved and the daily work routine of the laboratory settled to the period from 2 p.m. till 7 p.m. Monday to Friday and from 2 p.m. till 4 p.m. on Saturday. In autumn 1896, as soon as the reconstruction of the university was finished, the Institute moved again, this time settling in the upper floor of the two connected buildings Johanneum and Paulinum (see Figure 2).

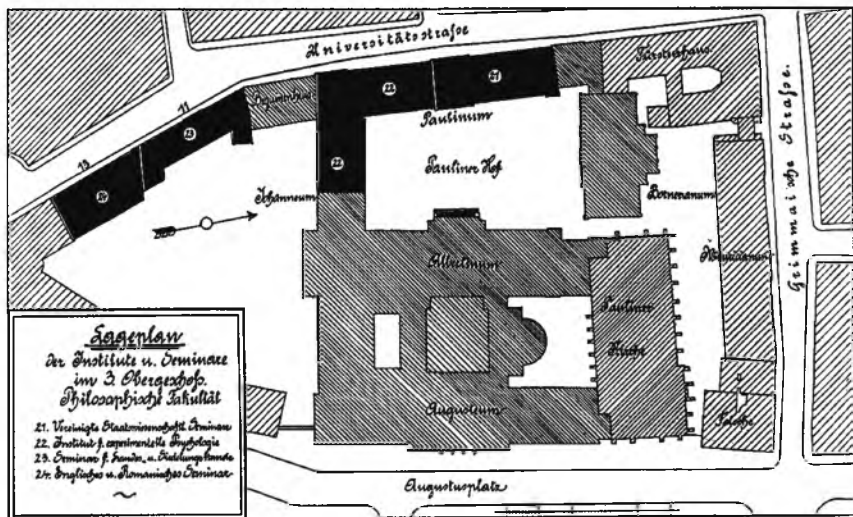


Figure 2. The location of Wundt's laboratory at the Faculty of Arts, Leipzig University (Wundt, 1909). Mark 22 – Institute of Experimental Psychology.

Wundt's Laboratory: A Closer Look

To summarize, Wundt's laboratory was successively situated in three different locations. Originally established in the Konvikt building (1874~1890), the laboratory temporarily moved to the Grimm Haus (~1890-1896) during the university's reconstruction, and then in 1896 it was settled in the university buildings Johanneum and Paulinum until 1943 when these buildings were bombed out to the ground.

Since Wundt's Institute for Experimental Psychology in Johanneum and Paulinum was designed on the basis of long-term experience with experimental work, its layout and workflow patterns became a standard for other laboratories scattered around the world. Detailed description of the Institute can be found in Wundt's (1909) article *The Institute for Experimental Psychology*, which was included in the proceedings published on the occasion of the 500th anniversary of the Leipzig University.

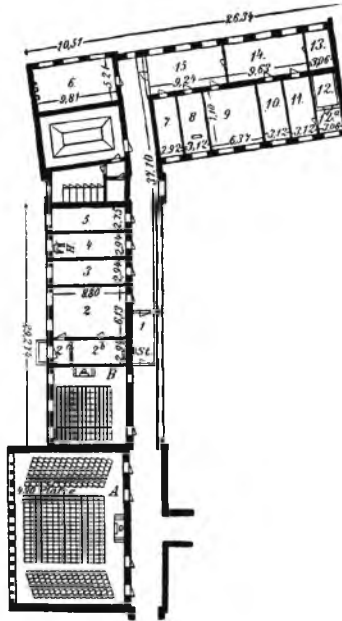


Figure 3. *The layout of Wundt's laboratory in Johanneum and Paulinum (Wundt, 1909). Detailed description provided in the text.*

The largest room of the Institute was the auditorium (letter A in Figure 3) for 490 students. This vast capacity was needed because psychology belonged to the compulsory courses at the faculty. The auditorium was amphitheatric with regularly shaped tall windows and atrium lighting. Black curtains pulled by electric motors enabled partial darkening. The lecturer's desk was equipped with electrical cabling and gas fixtures. Moreover, it was connected to the instruments in the laboratory rooms via cable wiring. The neighboring lecture hall (letter B) with the same equipment only provided 98 seats and enabled complete darkening.

There were two entrances to the Institute – one from the Albertinum building (see Figure 2) across the room marked with no. 1 in Figure 3, and the other

through the staircase between rooms 5 and 6. Room 2 was used for optical experiments and was equipped with darkening black curtains (as well as rooms 5 and 11). The room was partitioned, with sections 2a and 2b, painted matt black, serving as dark rooms. Heliostats for experiments with natural sunlight were installed on the balcony, which was south oriented. Section 2a served as a storage space for an arc lamp with accessories and a charging station for accumulators (the charging process produced toxic gas which had to be cleared from the room). Office 3 was occupied by the head of the Institute².

Illustrational teaching tools were stored in corner room 6, which was also used for Institute staff meetings. There were also 60 Meidinger's cells kept in this room, which provided stable direct current for some instruments such as chronoscopes. Capacity sources in room 6 were connected with all other rooms through heavy current wiring. In cases when stable current was not necessary, standard 110 V university wiring was used. All laboratory rooms in the Institute were also interconnected by telephone (data) lines.

The Paulinum wing was oriented in the direction from east to west. Room 15 served as a changing room and a storage space for demonstration boards used in lectures. Library and reading space were set in room 14. At the far end of the wing there was a workroom (13) equipped for the maintenance of mechanical instruments. Rooms 7 – 12 were separated by a massive wall from the other rooms and had double-pane windows oriented to the university's inner yard. These rooms were specifically designated for experiments with acoustic stimuli. Room 8 also had linoleum flooring to reduce footstep noise. Rooms 9 and 12 were even made almost totally soundproof using sandwich walls and upholstered doors. An enclosed subdivision of room 12, with no windows and walls painted black, could serve as a soundproof dark room.

Department of Psychology at the Leipzig University was kind enough to provide us with two photographs allowing us a look into the inner space of the Institute. Unfortunately, since these photos are undated, we can only hypothesize in which of the three locations they were taken. However, there are several clues in the pictures that can help us specify the time period. As we know, gas fixtures were installed in the Konvikt building during its reconstruction in 1883, and gas pipes and lamps are clearly visible in the right photograph in Figure 4. We also know that in the third location there were electrical wiring and lighting installed in the laboratory (after 1896), which are not present in the pictures. These clues strongly suggest that the photographs capture the appearance of the Institute in its second location between 1883 and 1896. The configuration of the depicted instruments also supports this conclusion.

2 Chronologically: Wilhelm Wundt (1896-1917), Felix Krüeger (1917-1936), Phillip Lersch (1939-1943).



Figure 4. Photographs of Wundt's laboratory rooms (the Leipzig University archive)

In the early years of the Institute's existence the necessary technical equipment was provided by mechanic Karl Krille. After his death the role of the main supplier of mechanical instruments was passed to Ernst Zimmermann. Many of the instruments were designed by Wundt himself or by other researchers in the laboratory, and it was Zimmermann who was particularly able to turn their ideas into the form of actual original instruments (Wundt, 1909). Zimmermann the Mechanic started his company in 1887 in Leipzig (Gundlach, 1983). Shortly after, he established a partnership with Psychological Institute at Leipzig University, which significantly stimulated the company's growth. Many students from around the world got in touch with Zimmermann's instruments at Wundt's Institute and after returning back home they ordered them for their own laboratories. This way Zimmermann multiplied his sales, and, consequently, the original custom production for Leipzig Institute was upgraded to mass production. Methodologically speaking, this virtual monopoly on the supply of research instruments led to considerable standardization of measurement and to the possibility of experiment replication and comparison of results yielded by different research facilities across the world.