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Preserving the History of Science – Journey of Old Psychological Instruments

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ABSTRACT
Creating of Collection of old scientific instruments of Laboratory for experimental psychology, Faculty of philosophy, University of Belgrade is an attempt to preserve a part of history of science in Serbia. There are around 100 instruments in Collection, which mostly came to Belgrade within German war reparations to Kingdom of Yugoslavia, after the World War I. Most of the instruments were made in workshop of E. Zimmermann, precise mechanic of the first psychology laboratory in the world, founded in 1879 by Wilhelm Wundt in Leipzig. They can be grouped on those aimed for examining visual and auditory perception, memory and learning, kimography and ergography and those designed for investigating emotions. Together with books and journals from 19th and beginning of 20th century, instruments create an ensemble based on which it is possible to reconstruct one psychological laboratory from the very beginning of development this scientific discipline.

Section: TECHNICAL NOTE

Keywords: Old scientific instruments; psychological laboratory; experimental psychology; history of science

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1. BIRTH OF A NEW SCIENTIFIC DISCIPLINE

At the end of the ninetieth century, approximately at the same time, two new laboratories were formed, in Leipzig by Wilhelm Wundt and in Chicago by William James. This was the beginning of a new scientific discipline – psychology. Problems that were investigated in these newly formed laboratories were sensory perception and thinking. These topics were not new in the history of science; they were borrowed from physics and philosophy [1].

Problems of sensory perception often interlaced with those studied in physics. In that sense optics is related to vision, acoustics to hearing, and thermodynamics to the perception of heat… In the past researchers did not separate those two classes of problems. For instance, Euclid and Ptolemy dealt with space perception, Kepler with function of eye lens, Galileo with link between sound frequency and tone pitch, Newton investigated relationship between light wavelengths and perceived color… But, since physics was formed as independent science, most physicists defined their aims in describing an objective, so called, outside world. In this sense, subjective reality, how these physical phenomena are related to our sensations, was out of their focus. Most of them would be interested in describing structure and nature of light, but they would not be interested in explaining why we perceive only wavelengths approximately between 400nm and 700nm. This way some problems are left unattended and a gap for a new discipline was created. That discipline was psychology [3].

Discovering relationship between the structure of physical reality and our experiences of it was the aim of first psychologists. So, why is it that we can only see certain range of light wavelengths, while some other animals perceive other wavelengths? Does it have something to do with adaptation to conditions in which we live? Why do we perceive a mixture of two colors as a new color, while mixture of tones as a chord? Why some chords sound harmonious and others do not? How do we perceive distances of objects if we only have two dimensional images on our retina? How come that we sometimes perceive physically equal lines as different? Why some chemically similar substances taste so different, while some chemically

different tastes pretty much the same? How come that we adopt easily to smell and almost never to pain, and what are the boundaries of our senses? All these questions lead us to more general one, how do we get to know external world which we live in, and what is the link between physical reality (stimulation), physiology and our consciousness?

The other set of problems was inherited from philosophy. From Aristotle to modern times, various philosophers were dealing with structure of concepts and judgments. They tried to develop formal axiomatic systems of mathematical logic and to establish rules of valid thinking and reasoning. One of the basic questions in this approach would be under what conditions we can infer certain conclusions from some premises [3].

On the other hand, psychologist shifted the focus from how thinking should work to how thinking actually works. What are the processes which occur between asking questions and giving answers? How do we recognize and understand letters, word and sentences? How do we learn, memorize and forget? What are the types of learning and how do they occur? How memory is structured and where is it located? How does the process of forgetting developing through time and how long does memory last?

Basic method for investigating above mentioned questions was taken from natural sciences. Researchers used experiment as basic method, trying to evoke and examine certain phenomena in controlled conditions. Only novelty in those experiments was that they required human or animal participants. This kind of approach required measurements, which further on asked for new instruments. This need for measuring and searching for answers on abandoned questions led to designing new, psychological instruments. At the beginning, researchers used existing instruments to measure and they were borrowed mostly form physics and physiology. During research of perception there was a need to generate various stimuli and record participants answers. For instance, they could generate precise optical or acoustic signals and record time taken to detect or recognize them. Sometimes emotional responses were measured through various physiological instruments. As research questions were multiplied instruments were often modified to fulfill new needs. Also, some new instruments were designed and used, since existing ones could not provide adequate measures. This process asked for institutionalization and first psychological laboratories were formed [1].

2. MEASURES OF THE MIND – FIRST LABORATORIES

As it was previously said, approximately at the same time two psychological laboratories were formed, in Chicago by Wilhelm James and in Leipzig by Wilhelm Wundt [1]. Both of them, James and Wundt had philosophical background, bringing lots of above mentioned questions. Beside that Wundt had education from medicine. Since first published paper, showing results of psychological research, came from Wundt's laboratory, we consider that first psychological laboratory was founded in 1879, in Leipzig (Figure 1). First printed article from psychological laboratory was published by Max Friedrich in the first issue of Wundt's journal "Philosophical studies" ("Philosophische Studien"). In Leipzig laboratory many significant names in the history of psychology worked as Wundt's junior associates. Some of them were Oswald Külpe, Emil Kraepelin, Stanley Hall and James Cattell [4].

Few years after founding laboratory moved into newly built university premises. It contained 15 rooms and 2 lecture halls,

Figure 1. Interior of a laboratory room.

half of which was intended for experimentation. Other rooms were library, conference room, offices, workroom and wardrobe. Most of the topics to be researched came from Wundt, which he tried to formulate according to interests of his senior associates. In this facility various instruments were settled. Some of them were used just for demonstrations while others were used in research. Devices that were used in psychophysical research could generate regular and measurable stimuli for different senses since they were used to investigate intensity of sensations. These devices were gravitational phonometers, photometers, pressure scales and so on [6].

In acoustic studies sets of tuning forks were used, devices for overtones, for sounding chord with amplifiers… In visual experiments researchers used device for extracting spectral components and various so-called color-mixers (such as Helmholtz color-mixer).

Also, various instruments for physiological measure were used, primarily to track physiological correlates of emotions. They were used for tracing the oscillations of pulse, breading and blood pressure volume – plethismographic, sphygmographic and pneumographic recording devices.

Chronometers were quite often used since many psychological experiments included, and they still include, reaction time. Under the term *reaction time* we consider a period form presentation of certain stimuli until participant's reaction to it and it is important sine enables researchers to track time course of psychological processes and even sometimes differentiate between them. Some instruments were used to generate auditory signals at certain time intervals, or to present stimuli at some limited time frame, such as tachistoscopes.

Final group of instruments consisted of devices for study of processes of recognition and recall. They are called mnemometers.

During first 30 years of its existence Wundt's laboratory published more than 100 articles. Main topics in those articles were problems of classical Fechner's psychophysics, visual and acoustic studies, and researches of smell, taste and touch, perception of time, attention, memory, emotions and experimental aesthetics. Most of those articles were published in already mentioned journal "Philosophical studies", which was renamed into "Psychological studies" in 1905 [6].

Wilhelm Wundt's laboratory had enormous influence on laboratories all over the world, and we can say that it disseminated psychological research which was born in Leipzig. One of the most famous examples of this dissemination was Laboratory of Experimental Psychology which was founded at Cornell University by one of Wundt's best-known student, Edward Titchener [5].

3. LIVING IN OBLIVION – BELGRADE LABORATORY

Professor Borislav Stevanović received his PhD in 1926 in experimental psychology from King's College, London [2]. His dissertation was on cognitive processes of reasoning. One year later, in the Faculty of Philosophy in Belgrade, Department of Psychology was formed and Prof. Stevanović becomes assistant professor. At that time, University of Belgrade granted books and equipment from the war reparation funds, after the World War I. Since Germany was giving goods to Yugoslavia through war reparation funds, Prof. Stevanović decided to order scientific equipment catalogues containing instruments form the first psychological laboratories in the world. Based in those catalogues he made a list and wrote a letter to the Dean of Faculty of Philosophy, Prof. Veselin Čajkanović in which he asks a certain number of instruments, valued at 4994 Reichsmarks (Figure 2).

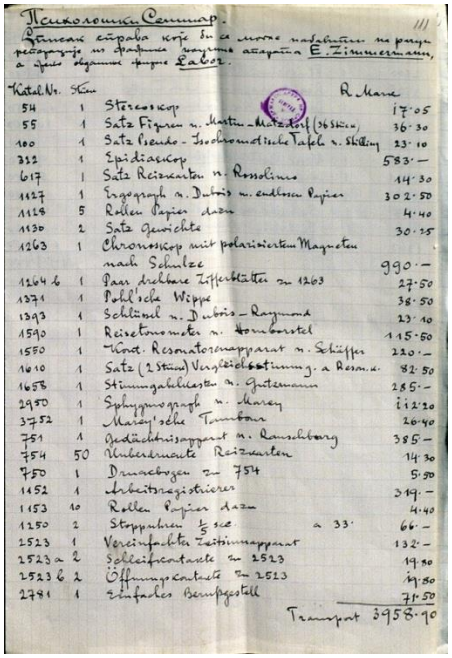

Figure 2. List of instruments with prices made by Prof. Borislav Stevanović based on catalogue of Zimmermann Company from Leipzig.

This letter and wish to provide psychological instruments probably indicates intention of Prof. Stevanović to form laboratory at the Faculty of Philosophy in Belgrade. His intentions were probably not to establish specialized laboratory for the study of certain area, such as perception, but rather to create laboratory which would deal with various aspects of experimental psychology. Equipment that Prof. Stevanović ordered can be grouped into devices for investigating auditory and visual perception, memory and learning, kymographic and ergographic recording and those for studying emotions. All these instruments did arrive in Belgrade, but unfortunately laboratory was not formed at that moment. Many years later, in year 1974, Prof. Predrag Ognjenović establishes Laboratory for Experimental Psychology, at the Department of Psychology, Faculty of Philosophy at University of Belgrade. Instruments were at the faculty for more than 40 years, but traces of their origin were lost, and they were threatened by oblivion [7].

Journey through space and time - Collection of old scientific instruments of Laboratory for Experimental Psychology

After creating Laboratory for Experimental Psychology in Belgrade, Prof. Ognjenović collects instruments and moves them into new laboratory. In 1982 Prof. Aleksandar Kostić establishes Collection of old scientific instruments of Laboratory for experimental psychology, Faculty of philosophy, University of Belgrade and instruments finally become a part of history of psychological science in Serbia and world. In 1992 Collection became part of the Association of Museums of Science and Technology of Serbia and instruments were granted that status of state-protected cultural asset [2].

Forming the Collection was only the beginning of reconstruction, which lead to new discoveries and questions. At the time when Collection was formed, many instruments were in poor condition, affected by rust, and most of them had some parts missing. Purpose of some instruments was hard to guess. Based on catalogues ordered by Prof. Stevanović, which were kept in the library of the Department of Psychology in Belgrade, and with help of Prof. Dejan Todorović, Prof. Kostić managed to reconstruct some instruments and to discover their purpose. Other instruments were reconstructed with the help of professors from the Department of Physics since they contained parts from old physical instruments. For some instruments purpose could only be guessed, since they were not listed in catalogues [7].

On the other track, in archive documentation, letter of Prof. Stevanović in which he orders instruments was found. This led to discovery of how instruments ended up in Belgrade and Prof. Stevanović intention to create psychological laboratory at the beginning of 20th century.

After the creation of Collection of old scientific instruments of Laboratory for experimental psychology, most of the instruments were reconstructed and their purpose is known. Also, their unusual journey through space and time was discovered, and we found their origins.

4. THRILL OF DISCOVERY – INSTRUMENTS IN THE COLLECTION

At present Collection of old scientific instruments of Laboratory for experimental psychology includes sixty instruments from various areas of experimental psychology (Figure 3).

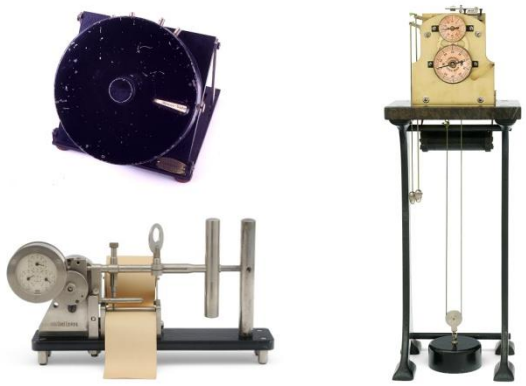

Figure 3. Old psychological instruments: Ranschburg's mnemometer (upper left), hand ergograph after Klemm (down left), chronometer after Schultze (right).

Most of the instruments in the Collection were made in workshop of E. Zimmermann, precise mechanic of the first psychology laboratory in the world, which was founded in year 1879 by Wilhelm Wundt in Leipzig. Other instruments were made by various manufacturers such as Diel, Boulitte, Palmer and Marx & Berndt. All instruments within Collection can be grouped on those aimed for examining visual and auditory perception, memory and learning, kimography and ergography and those designed for investigating emotions [2].

Research of cognitive processes often required measuring of reaction time and controlled presentation of stimuli. Therefore, instruments for investigating learning and memory and associations include chronometers, mnemometers and tachistoscopes. Probably most valuable instrument in the Collection is chronometer after Schultze (Figure 3), often used along with Ranschburg's mnemometer (Figure 3). For instance, chronometer was used to measure participant's reaction time to certain stimuli, presented briefly by mnemometer.

Studying perception requires controlled generation of visual, auditory, tactile and other types of stimulation. These instruments include stereoscopes for investigating depth perception, perimeters for measuring visual field, tuning forks and acumeter for auditory sensitivity, esthesiometers for measuring tactile sensitivity and colour mixers (Figure 4). Such mixers were, for example, used to rotate a two-coloured disc, which would be perceived as painted in neither of those, but in some third colour (a mixture of previous two).

Some fields of psychological research, such as experimental phonetics and the study of physiological parameters, included tracing time variations. In these fields kimography was widely applied. Various kymographs and chronometers constitute this part of the Collection.

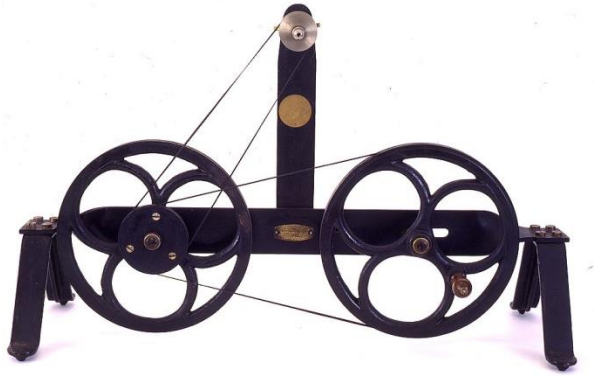

Figure 4. Colour mixer – instrument for investigating perception of colours.

As experimental research in psychology advanced, some practical applications of their results became possible. Therefore, instruments for study of fatigue and manual skills were invented and they are also included in the Collection. Those instruments are such as McDougal-Schuster apparatus, tremometer, tapping-test device, ergographs and sinusoid after Bonnardel.

And the last part of the Collection includes general purpose devices, such as reaction keys, commutators, electric circuit switches, metronomes, instruments for some physiological parameters such as pneumographs, and anthropometric compasses. They are applied in the study of various psychological phenomena and therefore are not limited to any specific domain.

Together with books and journals from 19th and beginning of 20th century, which are situated in the library of the Department of psychology, instruments create an ensemble based on which it is possible to reconstruct one psychological laboratory from the very beginning of development this scientific discipline.

Looking into the ways of function of these old instruments, their construction solutions and ways of making them, give us insight into spirit of one epoch, but they also tell us a story about beginnings of psychology as empirical science and its standards. Through these instruments we can forebode ways of thinking of scientists from the end of 19th century; we can hear them asking questions and solving problems. If we listen carefully, we will feel that they always tell us the same story on adventure of seeking and thrill of discovery.

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