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The beginnings of world of diagnosis within neurological research on the example of the Polish scholar Jan Piltz

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SUMMARY

Jan Piltz has gone down in the history of medicine, and not only of Polish medicine, as an eminent researcher into papillary reflexes. Our text is predominantly dedicated to this issue. Our primary goal was to present the course of the research conducted by this Polish scientist, providing details and depicting the conditions in which he reached his solutions; ones so significant for the development of neurology and medical practice. Our paper is a review, therefore, it includes references to both Piltz's own publications and descriptions of and references to his scientific achievements in the reports of other authors. However, before we touch upon this substantive item of our paper, we assume it would be worthwhile providing a short introduction of Jan Piltz as a scientist and one of the founding fathers of modern Polish neurology.

Key word: history of medicine, history of neurology, pupillary reflex, Westphal-Piltz phenomenon

EDUCATION

Jan Piltz (1870-1930) received a good education in the natural sciences, studying in Zurich, Switzerland, where he explored , for one year, the natural sciences and mathematics and, later on, medicine in Berne (Grochowski 2000). Already during his studies, he displayed a long-standing interest in research into the nervous system, finding his place at the Chair of Anatomy and Histology as an assistant's helper under the supervision of Prof. Philip Stöhr, specialising in embryological and histological issues (Lexicon 1933). It was only there that the young Piltz began learning the fundamentals of research into the nervous system. There is also some evidence to suggest that he could simultaneously have been working during that time at the Department of Brain Anatomy, supervised by Constantin von Monakow (Chłopicki 1964) In 1895, Piltz received his doctor's diploma. Through the support of professor August Forel, he received the post of assistant at his Department of Psychiatry at the University of Zurich and, in 1896, he accepted a similar job at the Psychiatric Department in Geneva, where his great masters were the eminent physicians: E. Olivet and A. Martin (Strojnowski 1981). With such good references at hand, he arrived in Russia, where, in 1897, at the University in Kazan, he had his Swiss diploma recognised, what enabled him to be employed at the Chair and Department of Neuropathology and Psychiatry of the Military-Medical University in St. Petersburg. Over there, under the watchful eye of Vladimir Bechterev, a world renowned scientist, Jan Piltz successfully presented his doctoral dissertation and was subsequently awarded the degree of Ph.D. Later the same year, he returned to Switzerland, where Prof. Eugen Bleuler appointed him the First Assistant of the Department at Burghölzli near Zurich. In order to make use of the Pole's skills in practice and to benefit from his experience, Professor Bleuler entrusted him with the reorganisation of the Department. Piltz performed outstandingly well in fulfilling these duties, gaining recognition and good opinions within medical circles. Therefore, Professor A. Mahaim decided to offer him the position of deputy director at his department and hospital in Lausanne (Artwiński 1930). Piltz'es intensive studies on pupillary reflexes can be traced back to this very period. In a surge of scientific enthusiasm, he decided to go to Paris to gain a more-in-depth knowledge of reflexes. During the whole of 1900, Piltz worked at the famous Department of Neurology, supervised by Professor Julesa Dejerine, at the Salpetrière Hospital in Paris. There he met Josef Babinski, an outstanding researcher; through him Piltz became better acquainted with the latest scientific developments in his field of interest. All in all, one may readily say that his stay in Paris ultimately shaped Piltz's career as a researcher. A subsequent research trip around Europe with study visits paid at several neurological-psychiatric departments, was to be the true culmination of his education.

WORK

A the end of 1901, Piltz arrived in Warsaw. Soon after he started his career at the Transfiguration Hospital in the Warsaw District of Praga, where he created from scratch a department of neurology, which he subsequently headed. Contributing his own means, he funded a histological laboratory with state-of-the-art equipment (Strojnowski 1981). In 1904, he was awarded the degree of Doctor of Medicine by the University in Lausanne and, a year later, he received the title of Associate Professor and was appointed Head of the Chair of Neurology and Psychiatry, the first one on Polish soil: this was the Chair and Department of Neuropathology and Psychiatry of the Jagiellonian University (later to become the Department of Neurology and Psychiatry).

Working conditions were extremely hard and the clinical activity had to be confined to a small outpatient unit, attached to Professor Wicherkiewicz's Department of Ophthalmology (Śródka 2011). In such a situation, priority was given to fundraising for the construction of a hospital complex which would meet the exacting demands that Piltz set for himself and his co-workers. Having acquired appropriate funds in Vienna and contracting creative architects and experienced engineers, Piltz was able to complete the construction of a modern clinical complex during the years 1908-1914 (Piltz 1929). Already during that period, he had received, in 1911, the title of full professor (Moskała, Gościński, Gajda 2007).

During World War I, the Hospital became part of the military health care structure and Professor Piltz was then the head of department of this fortress hospital. After the war, the Department regained its academic and fully civil character. Till his death in 1930, Piltz continued intensive research, gradually developing a scientific centre around his person (Tochowicz 1964). In the group of his students, and later eminent specialists, there was, among others, Eugeniusz Artwinski, who, under Piltz's supervision, received his postdoctoral qualifications in 1924 and, later on, in 1935, was awarded the title of Associate Professor of the Jagiellonian University. During World War II, he found his way to Lviv, where in 1941, he was appointed Head of the Neurological Department at the Lviv National Institute. Eugeniusz Brzezicki also came from the Piltz school, being an assistant at the Department of Neurology and Psychiatry of the Jagiellonian University during the years 1922-1939. After World War II, he was Head of that Department (1945-50) and, from 1950, he held the position of Head of the Chair and Department of Psychiatry at the Medical University in Cracow. Among Professor Piltz's assistants was Wladyslaw Chlopicki, who worked at the Department till 1936, when he became Head of the Neurological Ward at the Hospital of the Order of the Brothers Hospitallers in Cracow. After World War II, in 1951, he organised the Chair and Department of Neurology at the Silesian Medical University at Zabrze-Rokitnica, becoming its first head. Adam Kunicki, one of the pioneers of modern Polish neurosurgery was the organiser and the first head of the Chair and Department of Neurosurgery at the Medical University in Cracow, established in 1950, and also earns the right to be included among the group of Professor Piltz's pupils.

Among the leading research trends during the time of Jan Piltz's professorship at the Cracow Centre, beside the issue of pupillary reflexes discussed in detail below, sensory disturbances in organic diseases of the nervous system should be considered as a meaningful field of research in that part of Piltz's life. Piltz was intensively working on the design and development of sensation schemas at the cerebral, spinal and peripheral level. His findings, regarding pain and temperature sensation in cases of traumatic spinal injuries, were of considerable scientific and medical value (Herman 1958). He was also involved in studies on the nature of neuroses, especially post-war neuroses. In the field of psychiatry, Piltz addressed the problem of the heredity of psychic disorders, at the time an issue broadly discussed and analysed. He had significant achievements in the studies of characteropaties in the course of epilepsy, while being also the author of an original classification of psychic conditions. In collaboration with Radziwillowicz, he contributed to the modernisation and codification of some regulations in penal law, demonstrating the necessity for the continuous collaboration of lawyers and psychiatrists in investigations and legal proceedings (Moskała, Gościński, Gajda 2007).

Jan Piltz became famous in world science as the researcher of pupillary reflexes, which are of primary diagnostic value in medicine. On that occasion he designed and constructed an instrument to monitor and study pupillary movements in men, the first such device in the world. Those discoveries, basic for neurology and ophthalmology at the turn of the 19th century, may now in the main be considered of historical interest only. It is, however, worthwhile to reintroduce their principles to recall the huge contribution of this Polish scientist to the overall development of these branches of medicine.

The beginnings were indeed difficult, as an examination of eye reflexes was then not only a time-consuming, but also very complicated task; to be repeated several times in longer time intervals. Additionally, the direct, visual observation of pupils required extraordinary perceptiveness and scrupulosity on the part of the examining physician, together with special environmental conditions, ones minimising any external impulses which could disturb the reaction to the studied stimulus. The examination was usually arranged at a darkened room, lit with a gas lamp in such a way that the pupils were moderately dilated. Working in such conditions, Piltz discovered his first reflexes: ideomotor, i.e., imaginational, and the reflex of attention. Both reflexes were described by him in 1899.

The first reflex included dilation of the pupils at the imagination of muscular effort (e.g. hand movement) or a certain image (e.g., a dark object) and their stenosis when a source of light was imagined. An examined patient had to imagine a black hat, night darkness, the light of a gas burner or hand movement. Imagined ideas of neutral objects, such as a table, a fountain or a tree, had no effect on pupillary response. That phenomenon, observed both in sighted and blind subjects, proved the influence of psychic processes in the cerebral cortex on the width of pupils (Piltz 1899a,b). In the same experiment, Piltz described the reflex of attention, i.e., the reaction of pupils to the focus of attention on bright and dark objects, respectively. In that experiment, the examined patient fixed their eyes on a spot on the wall, directly ahead of their face, alternatively focusing their attention on the objects located on the side of their field of vision but without changing the gaze direction, i.e., without any pupil movements. Piltz proved that also in that case, an identical pupillary reflex underlay the pupillary width changes (Piltz 1899a).

In that same year, he published a report about another reflex, later on referred to as the Westphal-Piltz phenomenon; in fact, Piltz was in competition with Alexander Westphal, a German neurologist and psychiatrist, with regard to whom had been first in that discovery. The reflex in question included a pupillary stenosis in reaction to active eyelid constriction. That discovery was purely incidental, as Piltz was then interested in a totally different symptom, commonly described as the paradoxical pupillary response to light in subjects with paralysis. That symptom was assumed to be such that, directly after eye opening, the patient's pupil demonstrated high stenosis while then, under the effect of light, it dilated to its normal size. Piltz was analysing the subject for the first time when still an assistant at the psychiatric department at Lausanne. Already the first, simple experiment, carried out on a 30-year-old man with paralysis at the Burghölzli Hospital in Zurich, on October 16, 1898, led him to the conclusion that light was not the reflex-stimulating factor. After eye opening by the patient, the investigator saw his narrowed pupils, soon after dilating under the effect of room lighting. At that moment, Piltz covered the patient's eyes with an umbrella, failing the achieve the expected effect of regained papillary stenosis. Then he closed one patient's eye and again, there was no stenosis effect in the other eye. Eventually, he asked the patient to close his eyes with strong eyelid constriction. When the eyes were opened again, he saw a pin-like construction of the pupils, slowly regaining their normal diameter. He then concluded that active, strong eyelid construction was a key to that reflex.

Piltz then repeated the same experiment over the subsequent days with the same result, sharing his observation with his superior, professor Eugen Bleuler, director of the above-mentioned department, who only 11 days later demonstrated the phenomenon at his hospital (Pilz 1899c). In that way, the discovery was announced to a broader audience. At the beginning of November of that year, Piltz presented the experiment to professor Martin, his previous superior from Geneva. New observations of patients were started, this time focusing on a new reflex, referred to by the author as the "orbicularis reflex." Piltz himself examined 74 subjects, being convinced that his discovery had been the first. "Each examined patient was first asked to close both eyes very firmly to open them again, while the eyelids of the examined patient were not touched at all. The pupillary stenosis, observed in such experiments, I called the first pupillary reflex to distinguish it from the 2nd pupillary reflex, observed in the following conditions: first, an examiner, with his fingers, was holding apart the eyelids of one eye of the examined patient. Only then was the examined patient ordered to close his eyes very firmly. As a result of such an obstacle in the eye closing action, the examined person is forced to undertake much more effort, being willing to follow the examiner's order. Simultaneously, when the eyelids are held apart broadly enough, it is very easy to note that the pupil is narrowing. The eyeball is then most often drifting upwards and outwards or inwards, while stenosis is progressing." Summing up the results of studies, he diagnosed the first reflex in 22-43% of patients and in 1% of healthy subjects; the 2nd reflex was identified in 22-63% of patients and in 35% of healthy subjects (Pilz 1899 c,d). He did not then publish his results, working on a more exhaustive report on the issue. This is when the report was published in the 4th edition of the journal *Neurologisches Centralblatt* (1889). It was a report from a public talk with demonstrations, presented by Westphal at the Berlin Psychiatric Society on January 31, 1899 (Westphal 1899). During that talk, Westphal demonstrated a reflex, including pupillary stenosis, observed only during eye closing attempts with the eyelids are held apart by a doctor. It was therefore only a fragment of the reflex, which had already been described by Piltz. Moreover, Westphal did not examine healthy subjects, however, he was also convinced of being the first with the observation. Fortunately, the response of the Polish researcher was quick and accurate. On February 18, 1899, he delivered a talk for the Psychiatric-Neurological Society in Zurich, publishing his reports soon after in *Gazeta Lekarska* and in *Neurologisches Centrallblatt* of the same year (Piltz 1899 c,d]. In those papers, he described in detail the first results of his unfinished research, carried out on a small, in his opinion, group of patients: 22 subjects with paralysis, 25 catatonic patients, 8 subjects suffering from epilepsy, 9 patients suffering from tabetic disorders, 7 blind persons and 23 healthy ones. He concluded from the studies that it was “synkinesis resulting from a simultaneous incentive of the eye motor centre for the pupillary sphincter,” perceiving its role in the diagnostics of the degree of ophthalmoplegia, namely of the level of eye motor nerve paralysis. He decided to perform a thorough search through specialised literature to make certain that nobody had before described the symptom. He soon found out that symptom II had, in 1880, been described as a physiological phenomenon by professor Wilhelm Maximilian Wundt, a German physician and philosopher, proclaimed by his contemporaries a the creator of modern psychology (Piltz 1899 e). Then Harolf Gifford, an American ophthalmologist, described a similar phenomenon in 1896, to be then confirmed by R. Greef, who made a very good point that “the phenomenon in question is more difficult to be demonstrated on subjects with sharp eye, since the light-induced pupillary contraction in well illuminated space overrides orbicular muscle reaction” (Piltz 1899c) . Nobody had described the symptom before Piltz I (Piltz 1899c) . It is worth mentioning that in the currently published Lexicon of pathological syndromes and symptoms, edited by M. Fejgin, priority has been given to Westphal’s discovery, incorrectly regarding the year 1890 as the date of the symptom description by Piltz (Fejgin 1959).

The above-mentioned observations were only an introduction to Piltz’s further studies on light-induced paradoxical pupillary dilatation. Again, he applied very stringent research conditions: “The patient is quietly sitting, trying not to move either his eyeballs or eyelids. A lamp is located on the left side of the patient, when the left eye is examined, and on the right side of the patient, when studying the right eye. A big, 5-litre bottle, filled with ice-cold water, was placed between the lamp and the patient’s eye, to absorb all heat radiation, while permeating light energy only. Using a standard magnifying glass (placed between the eye and the bottle), the eye is lit with a bundle of focusing light rays. Behind the magnifying glass, (i.e., between the glass and the bottle, a black screen is installed;

the screen movement can either light or cover the examined eye. Piltz soon found out that the phenomenon, till then assumed by researchers to be a pupillary reaction to light, could have been, for example, the previously described orbicular reflex or that it could have been induced by the heat generated by the light source or, eventually, a reaction to the eyeballs moving in different ways. A true paradoxical reflex, consisting in dilatation of a rigid, narrow pupil under light effects or its variation, described by Piltz and consisting in dilatation of a narrow pupil after the light stimulus is taken away, is a very rare phenomenon, observed only in severe, organic injuries of the central nervous system, e.g., in tertiary syphilis (Piltz 1902, 19). The scientist did not focus his research attention on pupillary reflexes alone, trying to localise the anatomical changes which could be responsible for habitual reflexes. He, for many years, carried out studies on animals, dissecting proper fragments of their cerebral cortex to establish the eye motor pathways or delivering electric stimuli to various areas in the cerebral cortex in search of the cortical centres of pupillary stenosis and dilatation (Piltz 1899a; Chłopicki 1931).

Piltz was also famous for his excellent diagnostic report about irregular pupillary contours in the course of organic nervous diseases. The values of that scholarly study were not only associated with finding pupillary contour changes related to specific medical conditions but, first of all, with the possibility to determine the character and cause of disorders. Experimenting on rabbits, cats and dogs, he achieved pupillary stenosis or dilatation by electric stimulation of the appropriate nerve fibres and then, by the simultaneous stimulation of several different fibres, he managed to change pupil shape. In morphine anaesthesia, he cut animal medulla with a scalpel, dissected the eyeball with incoming nerves in order to separate the delicate, peripheral branches of the optic nerve for it to be then stimulated with induction current from copper electrodes. “Therefore, taking into account the fact that in experiments on animals, while electrically stimulating separate branches of long and short ciliary nerves, pupillary contour changes are achieved, being almost identical to the changes perceived in the course of organic nervous diseases, it is to be assumed that the latter are nothing more than the conditions of irritation, palsy or partial paralysis of the iris, depending on the pathological changes in the separate branches of long and short ciliary nerves or, rather at their centres” (Piltz 1902b).

We should add with some emphasis that Piltz attached great importance to as humane as possible treatment of the animals, which he sacrificed for scientific development. However, for obvious reasons, the experimental studies on animals had no actual influence on the studies in man. A remarkable achievement of Piltz’s was his design of an instrument, the first in the world, allowing for non-invasive studies of pupillary movements in man, without the necessity to maintain rigorous conditions and providing an option to document the course of the experiment through photography. Piltz had already felt uneasy about the necessity to have such an instrument available during his stay at the Nervous-Psychiatric Department of professor Bechterev in St. Petersburg, where he initiated works on the topography of cortical pupillary centres. The available gear, designed according to Bellarminov's concept, while presenting various modifications, was not appropriate for *in vivo* studies. In collaboration with Piotr Lebiedzinski, an engineer from Warsaw, Piltz designed an instrument for studies of pupillary movements in humans, the first such device in the world. It was a user-friendly solution and could be used both for taking photos and direct observations. It was a breakthrough study method which enabled accurate comparative evaluations and the documentation of data (Piltz 1904).

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